APPLIED BIOPHYSICS AND BIOCHEMISTRY IN THE LEARNING EXPERIENCES OF STUDENT NURSES IN THE SURGICAL UNIT

by

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Declaration

Student number: 400-391-8

I declare that *APPLIED BIOPHYSICS AND BIOCHEMISTRY IN THE LEARNING EXPERIENCES OF STUDENT NURSES IN THE SURGICAL UNIT* is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

JS Ntlokotsi ..... 26 01 1999 .....

SIGNATURE **DATE**

(JS NTLOKOTSI)

Dedication

To: My late mother Yeye,
three sisters Florence, Hilda and Gloria
who lovingly supported my personal and professional development

SUMMARY

APPLIED BIOPHYSICS AND BIOCHEMISTRY IN THE LEARNING EXPERIENCES OF STUDENT NURSES IN THE SURGICAL UNIT

STUDENT:	Joyce Shirley Ntlokotsi
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A descriptive survey was used in order to determine

- whether professional nurses are capable of teaching student nurses the application of biophysics and biochemistry related to certain nursing activities/procedures in the surgical unit
- student nurses' knowledge of biophysics and biochemistry related to nursing activities/procedures in the surgical unit

The two target groups consisted of student nurses of a Gauteng nursing college and the professional nurses working in the surgical units of the four hospital satellite campuses where these students do their practica. Accidental sampling was used. Two questionnaires were designed: one for each group.

Findings revealed that student nurses felt that biophysics and biochemistry were often not applied by professional nurses during clinical teaching. Professional nurses fe' they had problems in identifying and applying biophysics and biochemistry principles during clinical teaching. Recommendations were made for nursing practice, nursing education and further research.

Key terms:

Applied biophysics; applied biochemistry; bionursing; meaningful learning; clinical teaching; theory/practice integration.

OPSOMMING

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Daar heers groot komer oor die toepassing van biofisika en biochemie in die kliniese opset. Voortspruitend uit hierdie probleemstelling is twee vrae gevra in hierdie studie, naamlik:

- Is geregistreerde verpleegkundiges daartoe in staat om studentverpleegkundiges te help om die biofisika- en biochemie-konsepte wat hulle leer, toe te pas in die sjirurgiese eenheid?

- Kan studentverpleegkundiges die biofisika- en biochemie-konsepte wat hulle leer, toepas in die sjirurgiese eenheid?

Doelwitte van die studie was om

- 'n oorsig te gee oor verbandhoudende literatuur
- te bepaal oor watter biofisika- en biochemie-kennis studentverpleegkundiges beskik wat verband hou met verpleegaksies in sjirurgiese eenhede
- te bepaal of geregistreerde verpleegkundiges studentverpleegkundiges kan onderrig in die toepassing van biofisika en biochemie wat verband hou met sekere verpleegaksies in sjirurgiese eenhede

Die navorsingsbenadering wat gebruik is, is die beskrywende opname. Teikengroepe vir die studie was fase II studentverpleegkundiges van 'n Gauteng Verpleegkollege en geregistreerde verpleegkundiges wat in die sjirurgiese eenhede werk van vier Gautengse hospitale wat dien as satelliet kampusse vir hierdie verpleegkollege. Twee vraelyste, respektiewelik gerig aan die studentverpleegkundiges en die geregistreerde verpleegkundiges, is gebruik as instrumente. Toevallige steekproeftrekking is gebruik.

Analise van die data het getoon dat studentverpleegkundiges gevoel het hulle is nie betrek in die beplanning van kliniese onderrig nie en ook dat biofisika en biochemie dikwels nie toegepas is tydens kliniese onderrig deur geregistreerde verpleegkundiges nie. Geregistreerde verpleegkundiges het gevoel hulle het probleme in die identifisering en toepassing van biofisika- en biochemie-beginsels tydens kliniese onderrig. Bevindings kan nie veralgemeen word nie. Aanbevelings vir verpleegpraktyk, -onderwys en verdere navorsing is gemaak.

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CHAPTER 1

Orientation to the research

1.1 INTRODUCTION

Contemporary nursing leaders regard the integration of biophysics and biochemistry as essential to professional nursing education, practice and research (Haoses 1990:7; Hawkins 1981:31; Infante 1985:13; Smith 1992:16). In the foreword to *Learning to nurse: integrating theory and practice*, Alexander (1983:56) states that it is well-known that integrating theory and practice in nursing education presents a problem. The concern of integrating biophysics and biochemistry with other nursing subjects and their application in the clinical situation continues. However, very little research appears to have been carried out on the way these subjects are taught, learnt and applied in nursing (Akinsanya 1987:267; Montague 1981:146). Furthermore, Trnobranski (1993:495) cites that research on the role of the biological sciences in nursing practice and education has largely been ignored. Moreover there has been little research to establish a direct link between nursing and the life sciences (Akinsanya 1984:222). Research is thus needed to both the content and level of nursing curriculum in relation to biological sciences and the needs of practising nurses.

Montague (1981:148) suggests that identifying the precise biological science knowledge on which the safe practice of nursing activities rests will be a difficult and challenging research task. The part of nursing which is dependent on a knowledge of biological sciences is probably more obviously affected by changes in medical sciences than other aspects of nursing are (Wilson 1975:3). Rapid changes in technology and therapeutics not only necessitate a commitment to updating by continuing professional education but may also demand curriculum revision or adjustment (Jordan & Reid 1997:170). Curricula that integrate the practice of nursing with a well-defined theory base continue to be a major goal for professional nursing education (Smith 1992:17).

Infante (1985:23) explains further that the emphasis in the clinical laboratory should not be on how to care but on how to apply scientific knowledge to the care of patients. Yura, Torres, Chiani, Frank, Lynch, McKay, Stanton, Carlson, O'Leary and Kelley (1986:226) support present nursing curricula that develop students who can discover, create, express meanings and think rather than merely accumulate facts. Brink and Searle (1988:2) concur, stating that students must be equipped with scientific, technical, social and professional competence to develop the flexibility and creativity required to initiate and cope with change and render quality care in a changing environment.

1.2 BACKGROUND TO THE PROBLEM

When scientific principles and concepts are taught to student nurses in the classroom they are often related to nursing practice by simulation or not at all (De Young 1990:142; Henderson 1982:37). The relevance of biophysics and biochemistry is thus queried by students (Henderson 1982:57).

Simulation of procedures is particularly appropriate for trying techniques and generally gaining competence in managing parts of the total practice role but lacks the dynamic impact of a client or family actually present in the real life situation. The clinical situation is therefore the only normal setting where nurse-client interaction occurs. It serves as the ultimate site where students can apply previously learnt scientific principles to the real or

practical situation (Infante 1985:35; Lowane 1990:2). The problem is that what is taught in the classroom is not implemented in nursing practice (Alexander 1983:57). This is not a new problem because in 1949 Tyler (1949:52) indicated that in some professional courses, such as nursing, specific procedures are taught without bringing in general or basic scientific concepts. The result is that students cannot make generalisations on which to meet new situations in the profession. In other instances general scientific principles are taught without connecting them in any way to specific procedures. This often results in the principles being so abstract as to be meaningless to the students and also means that there is very little transfer of what is actually taught in the classroom to actual procedures in the clinical area. Haoses (1990:8) agrees by citing that students are deprived of the opportunity to implement these scientific principles in the clinical situation. Boyles' law on the effect of pressure and temperature on the volume of gases has an important application in understanding the respiratory function (lung volume and the carriage of gases in the blood) when nursing a patient on a ventilator (Montague 1981:133). In the clinical area students are taught how to take and record blood pressure without making them aware of Pascal's law of the transmission of liquids at rest. These scientific laws are thus not applied.

McFarlane (1977:267) indicates that the theory is clearly divorced from practice. The school and the classroom teacher are regarded as irrelevant to the student who values the ward as the real situation. Their learning strategies are managed in such a way that relatively few students achieve any degree of correlation between theory and practice. Tutors often teach theory that is not part of nursing theory because it is potentially unrelated to practice and taught in a way and context that is perceived as irrelevant to nursing practice. A scientific principle should thus be relevant to students' learning experiences because immediacy factor is important so that student nurses link scientific principles to patient care as often and as soon as possible (Greaves 1987:65).

The problem is compounded by the reluctance of classroom tutors to follow-up on students in the clinical area. Mashaba and Brink (1994:49) cite the following reasons for the clinical aspects of the nurse educator's role being poor or neglected:

- Nurse educators have a negative attitude towards bedside work.
- There is a poor tutor-student ratio.
- The term "accompaniment of students" is misinterpreted.
- Some tutors are not confident in the clinical area.
- Some tutors believe that clinical instructors should do all the clinical work.
- Finally poor human relations between clinical nurse practitioners and nurse educators are alleged to actually keep some nurse educators from following-up on students in the clinical area.

In addition, Jolley and Allan (1989:30) maintain that nurse educators have been required to teach aspects of practice like "haemodialysis" in which they have no clinical experience. In some instances this has created insecurity in nurse educators and reluctance to undertake teaching in clinical settings. Likewise, many clinical nurse practitioners feel unprepared for a teaching role and are therefore reluctant to combine this with their direct patient care (Jolley & Allan 1989:30). The result is that nurse education is becoming almost irrelevant to patient care with the nurse educator away from the ward. The tutor is thus unable to obtain feedback on the effect of her teaching from students and makes no significant input to patient care. Akinsanya (1984:222) identifies another drawback when he states that, unlike medical students, nursing students are faced with a mass of theoretical material often learnt by rote (parrot fashion) without applying this theory in the simulation room or practical or life situation. Trnobranski (1993:498) points out that an important feature of biological sciences is that they are essentially experimental subjects but in the context of nursing they are taught and learnt theoretically. Hence student nurses learn about chemical reactions of elements without seeing them in real-life situation. Moreover, textbooks and other learning resources on the life sciences are almost always based on medical rather than nursing foundations because few nurses specialise in life sciences at graduate level. In the case of the life sciences, the problem is that, unlike medical students, most of the time student nurses are not taught by physiologists, physicists or tutors who have specialised qualifications in these disciplines themselves (Akinsanya 1984:224). There are other problems, too. Haoses (1990:15) states that the general complaint of students is that science is irrelevant, not creative and too arithmetical. Referring to students in California, Jones

(1976:581), states that many beginning nursing students perceive chemistry, physics and other basic science requirements as of little relevance to them and serving primarily to eliminate weaker students from the nursing programme. With reference to nursing students in Great Britain, Akinsanya and Hayward (1980:429) point out that because of the limited educational background of nurse learners, biological sciences present a source of considerable anxiety to most learners, especially those who did not study science at school. Wilson (1975:3) adds that there is no definition of the range and standard of knowledge of biological sciences required by nurses.

1.3 PROBLEM STATEMENT AND RESEARCH QUESTIONS

The application of biophysics and biochemistry in the clinical setting is a cause of much concern. This led the researcher to investigate this problem more intensively. Specific problems in the integration of these sciences in the learning experiences of student nurses are identified as potential factors that affect the quality of patient care, namely:

- nurse-teachers' difficulty to engage in clinical teaching to assist student nurses in the application of biological science knowledge in real-life situations
- the inability of professional nurses who act as mentors in the clinical areas to articulate the relevance of biological science as a basis of nursing care (Clarke 1995:406)
- no definition of the required level of knowledge of the biological sciences to practice (Wilson 1975:3)
- an abrogation of biological sciences in favour of social sciences by some nursing theorists
- the transition of nurse education into higher education has failed to ensure uniformity in biological science education (Wharrad, Allcock & Chapple 1994:436)

These problems led to the following questions:

- Are professional nurses able to help student nurses apply the biophysics and

biochemistry principles and concepts they learn in the surgical unit?

- Are student nurses able to apply the biophysics and biochemistry principles and concepts they have learnt in the surgical unit?

1.4 IMPORTANCE OF THE PROBLEM

Student nurses should be helped to develop a body of scientific knowledge, not only to enhance their understanding of clinical nursing but also to apply it directly to the benefit of patients (Jordan & Reid 1997:169).

According to Hinwood (1981:preface), the integration of the strands of science is designed to assist student nurses to understand the total effect of science on nursing practice and the body function. Hence Trnobranski (1993:495) points out that students should have a sound grounding in social and behavioural sciences but a holistic approach to caring for people should also adequately emphasise the principles of biological sciences. Hofmeyer (1991:1) states that her objective in writing for nurses was to promote an understanding of the reasons for many techniques and procedures instead of learning mechanically and performing the procedures automatically without any insight. For example, the anaesthetised patient with paralysis of the diaphragm who is unable to breathe is placed on the ventilator or Boyles machine. Student nurses who understand the meaning and application of Boyles' law and know to manipulate the machine will also know the rationale for putting the patient on the ventilator. Just as student nurses need a knowledge and understanding of biological sciences, the content taught should be selected for its relevance to nursing (Wilson 1975:1). Student exposure to clinical learning experiences should thus tally with the basic theoretical background. Naturally, clinical learning experiences should be well-planned and closely supervised to best accomplish learning objectives. Student nurses should know what is expected of them and ward staff should know what to expect from student nurses. Clearly defined objectives should thus be set according to the level of student training (Fothergill-Bourbonnais & Higuchi 1995:40; Lowane 1990:3). When nursing a patient in electrolyte imbalance, for example, a learning objective may be stated as "to care for a person in electrolyte imbalance".

This objective is vague in the sense that the student nurse will not be clear on what it is she needs to learn about a person in electrolyte imbalance. Instead, a series of refined clear attainable objectives should be set as definite goals for the student nurse. According to Infante (1985:25), the student nurse should be able to

- observe the skin turgor of a person in electrolyte imbalance
- interpret blood electrolyte laboratory results by comparing them with normal values
- relate the patient's vital signs to the improvement or regression of electrolyte imbalance
- plan the dietary intake of minerals and electrolytes according to the patient's condition and needs
- administer and regulate intravenous electrolyte solutions accurately

The student nurse is expected to draw on all the science knowledge she possesses and apply this knowledge in a variety of nursing situations. She is expected to see the relationship between facts, principles and concepts and their relevance to particular problems in nursing and from this scientific background to make sound decisions in order to resolve patients' problems (Nordmark & Rohweder 1975:7-8).

Drew (1988:26) warns the nursing profession not to devalue the theoretical knowledge base of the natural sciences as it often helps to evaluate human physiological responses and thus direct nursing practice. She also stresses that although technical skills can be performed without a clear theoretical understanding by technicians, professional nurses provide a higher level of care by giving comprehensive theory-based care with knowledge from the natural sciences. This statement is further supported by Holmes (1972:655), who states that nurses increasingly depend upon knowledge from natural sciences to manoeuvre or manipulate machines developed by modern technology. A sound scientific basis for practice should thus be the aim of every nurse who wished to uplift the standard of patient care (McFarlane 1977:445).

1.5 DEFINITION OF TERMS

The following key terms in this study are defined:

Integration of subjects: This means breaking down barriers between subject areas and bringing essential areas of the curriculum together to form a unified and meaningful whole (Greaves 1987:126).

Biophysics: This is the science of the physical forces acting on the cells of the living body (Dox, Melloni & Eisner 1979:62).

Biochemistry: This is the study of interaction and reaction of matter and energy occurring in the living organism (Jaros & Breur 1991:1; Marieb 1991:26).

Learning experience: This is participation by the student nurse in a planned learning activity which enables some form of learning to take place (Greaves 1987:129).

Student nurse: This is a student who has been admitted to the four-year comprehensive course for a Diploma in General Nursing leading to registration as a nurse (general, psychiatry, community health nursing science) and a midwife according to the South African Nursing Council requirements for the course.

Surgical unit: This is the section in a hospital that accommodates patients who have undergone surgery.

1.6 ASSUMPTIONS (PREMISES) OF THE STUDY

An assumption is a proposition or statement whose truth or validity is either considered self-evident or has been satisfactorily accepted (Dempsey & Dempsey 1986:71; Seaman 1987:134; Polit & Hungler 1991:88). An investigation into the application of biophysics and biochemistry in the learning experiences of student nurses makes certain assumptions,

namely:

- The scientific basis of nursing education is formulated on biological sciences.
- Biophysics and biochemistry should be integrated with other nursing subjects.
- Scientific principles should be relevant to students' learning experiences so that students understand the link between scientific principles and patient care as often and as soon as possible.

1.7 AIM AND OBJECTIVES OF THE STUDY

The purpose of the study is to determine whether professional nurses in surgical units are able to help student nurses apply the principles of biophysics and biochemistry they have learnt.

The objectives of the study are to

- review related literature which indicates
  - the importance of theory/practice integration in nursing and research findings on this issue
  - the importance of biophysics and biochemistry in the nursing curriculum and research findings on this issue
- determine student nurses' knowledge of biophysics and biochemistry related to certain nursing activities/procedures in surgical units
- determine whether professional nurses' are capable of teaching student nurses the application of biophysics and biochemistry related to certain nursing activities/procedures in surgical units
- make recommendations for nursing practice and nursing education based on this study

1.8 METHODOLOGY

The methodology of the study is discussed in chapter 3. Here it will be dealt with briefly.

A descriptive survey is used to determine how well student nurses and professional nurses are able to apply the principles of biophysics and biochemistry applicable in surgical units.

The target groups are professional nurses working in surgical units in four Gauteng hospitals that serve as satellite campuses to a specific nursing college and stage II student nurses allocated to surgical units of these four hospital satellite campuses.

Sampling is more economical and efficient than collecting data from the entire population. For practical reasons, sampling was used in this study.

Two questionnaires directed to student nurses and professional nurses, respectively, were used as instruments.

1.9 SCOPE AND LIMITATIONS OF THE STUDY

This study focusses on student nurses' application of biophysics and biochemistry in the surgical unit. To make the project manageable and to gain easy access to the research site, four hospital satellite campuses under one nursing college in Gauteng Province were selected for the study. The findings of this study cannot be generalised to other colleges and hospitals throughout South Africa.

The study was carried out on stage II student nurses allocated to the surgical unit on day duty at four hospital campuses. All the professional nurses allocated to these surgical units on day duty also formed part of the population. To prevent the results being biased, classroom and clinical tutors were not included in the study because there were only two tutors (researcher included) teaching the subject and one clinical tutor for each hospital satellite campus.

The study was limited to the application of biophysics and biochemistry in the clinical setting. It did not consider other biological sciences, such as anatomy and physiology as inclusion of these subjects would have made the study too big and biophysics and biochemistry serve as the foundation and building blocks of anatomy and physiology.

Student nurses and professional nurses working in surgical wards were used in this study. Medical, gynaecological, obstetrical, paediatric and orthopaedic wards were excluded from the study.

The researcher explained the scope of research to the superintendents and chief matrons of the four hospital satellite campuses who, in turn, held staff meetings for the purpose of encouraging both student nurses and professional nurses to respond to the questionnaires.

1.10 STRUCTURE OF THE STUDY

The chapters of this study cover the following aspects of the research project.

Chapter 1: Orientation to the research

Chapter 2: Literature review

Chapter 3: Research methodology

Chapter 4: Data analysis, findings and recommendations

Chapter 5: Overview of the findings, recommendations, limitations of the study and concluding remarks

CHAPTER 2

Literature review

2.1 INTRODUCTION

A literature review is an essential part of a research project for many reasons. A careful study of the available literature enables researchers to acquaint themselves with what has already been done and what is currently being done on the problem. It helps researchers to obtain the most recent facts about findings on the problem and to delineate their problem effectively. The findings give basis and support to the study in general (Bush 1985:20; Polit & Hungler 1991:88; Treece & Treece 1986:92; Uys & Basson 1985:20).

According to Burns and Grove (1993:200), a framework is the abstract logical structure of meaning that guides the development of a study and enables researchers to link the findings to the existing body of knowledge.

2.2 LITERATURE REVIEW

The literature review in this study is aimed at establishing the importance of theory-practice integration in nursing and of the subjects, biophysics and biochemistry in a nursing curriculum as well as discussing research findings on theory-practice integration in nursing and on the application of scientific principles in nursing.

2.2.1 The importance of theory-practice integration in nursing

Teaching connections between theory and practice is not a new educational idea. In 1949 Tyler (1949:55) urged that correlation of theory and practice was essential to professional education. More than that, nursing is a practice discipline and therefore any theory of nursing must be intimately related to this practice (McFarlane 1977:224). Theory originates in practice and is refined by research. To be complete, theory must return to practice (Jolley & Allan 1989:49).

Hawkins (1981:8) recognises the value of clinical experience as complementary to classroom learning rather than separate and distinct. Applying the content presented in the classroom in a clinical setting also increases students' retention of the newly learnt facts, concepts and theory. Students reported that they were able to understand some concepts explained in the classroom and content from textbooks only after they observed or practised the clinical application (Wilson 1994:83). As mentioned, Yura et al (1986:226) support present nursing model curricula that integrate the practice of nursing with a well-defined theory base. Clear linkages must be evident between practice and theory to conclude that practice is theory driven rather than rote steps. It is the theory driven nature of practice that gives intended meanings to procedural steps (Smith 1992:18).

2.2.2 The importance of biophysics and biochemistry in the nursing curriculum

The biological sciences are the foundations on which scientific nursing is built (Greaves 1984:54). Without a thorough understanding of the scientific foundation of nursing, of

which applied biophysics and biochemistry form a vital part, student nurses, professional nurses, clinical instructors and classroom tutors place patients' lives at risk. Unlike behavioural sciences, in biological sciences there is little margin for error. For example, misreading of Sodium (Na) for Potassium (K) or a misplaced decimal point in an insulin dose are well-known causes of fatalities or medico legal hazards (Jordan & Reid 1997:170). Patients are likely to complain about mistakes in their physical care but appear rather indifferent to the psychological care offered (Jordan & Reid 1997:170).

Jaros and Breur (1991:foreword) maintain that it is imperative for safe nursing practice for physics and chemistry to be taught with an understanding of the application of the principles to treatment and care. Physical care depends on knowledge of biological sciences. Knowledge of these biological sciences enables student nurses to gather and evaluate evidence and to learn to discriminate between valuable and non-essential observations. They learn to understand the physical and other manifestations associated with ill-health. This biological knowledge therefore forms the basis for the judgements which nurses are called upon to make (Jordan & Reid 1997:170). In addition, Akinsanya (1987:269) states that professional competence should reflect informed decision-making based on these life sciences at all times in circumstances that may be either routine or emergency.

Biophysics and biochemistry form the building blocks of physiology, anatomy and pharmacology. Physiology focusses on the cellular or molecular level because what the body can do ultimately depends on the operation of its individual cells and the chemical reactions in the cells (Marieb 1991:6).

A thorough understanding of physiology also rests on the knowledge of principles of physics that helps to explain phenomena, like the flow of electricity. The flow of electricity can be applied in the electrical activity of the heart muscle (Hofmeyer 1991:126). Not only is biochemistry essential to understand the physiology of the human body, but it is also an important factor in understanding pathology. A breakdown in the biochemical processes of the body leads to pathological conditions (Brink & Searle 1988:8).

Many situations can be described to support what is said above. For example, in the classroom students learn that it is important to turn patients with mobility problems (eg unconscious patients) every two hours to prevent alterations in skin integrity. However, it is only in the clinical setting that students can apply this knowledge so that it takes on meaning. By caring for many patients students understand when to turn patients, how to turn them and who is at highest risk of developing pressure sores (Fothergill-Bourbonnais & Higuchi 1995:38). If students understand Newton's third law of motion that states that for every action there is an equal and opposite reaction (Hinwood 1981:48; Hofmeyer 1991:101), they will definitely know that in the case of using an ordinary mattress, when nursing an unconscious patient, the heavy parts of a patient's body press more firmly against the mattress than the other parts and the mattress, in turn, presses more firmly against those parts (application of Newton's third law of motion). As a result of this, pressure sores may develop. It is therefore imperative to nurse an unconscious patient on an air or water mattress to prevent the formation of pressure sores because, according to Pascal's law, the pressure exerted by the weight of the patient is spread evenly by the air or water to all parts of the body that are in contact with the mattress (Hofmeyer 1991:75). Another example is that nurses will only be able to interpret the electrocardiogram deflections if they understand electricity in the living cell (Hofmeyer 1991:127).

Body functions, like chemical digestion, are incomprehensible without an understanding of the underlying physics and chemistry (Marieb 1992:6). For example, hydrochloric acid is a chemical substance that promotes protein digestion in the stomach. Too much secretion of hydrochloric acid erodes stomach mucosa and may cause a peptic ulcer. If they understand the medical uses and dangers of acids and bases, students will know the rationale for giving patients with an ulcer aluminium hydroxide as a curative measure. It is thus clear that these sciences (biophysics and biochemistry) represent one of the key areas of scientific underpinning of nursing practice that without a thorough understanding of the scientific foundations of nursing, student nurses, nurse practitioners and clinical instructors will not be able to give a rationale for their nursing action (Akinsanya 1987:269; Smith 1992:17). Akinsanya (1987:272) believes that theoretical input from the life sciences must be clearly defined for nursing practice. He stresses the value of understanding concepts, principles and

theory from the life sciences in order to understand the rationale for every nursing action.

The provision of effective care is also dependent on an understanding of patients' physical needs (Trnobranski 1993:495). Decisions about physiological parameters must be based on the principles of the biological sciences underlying physical illness. In Maslow's hierarchy of needs he states that individual physiological and safety needs should be met before other hierarchical needs such as love and belonging can be fulfilled (Jordan & Reid 1997:173). It is certainly true that nursing students should be firmly grounded in social and behavioural sciences, but a holistic approach to "caring" for people should also adequately emphasise the principles of biological sciences (Trnobranski 1993:495). With reference to the holistic approach, Clarke (1995:405) points out that the combination of knowledge from biological, social and psychological sciences and the ability to relate one area of knowledge to another and apply it to the particular problem presented, is what distinguish the professional from the non-professional.

The natural sciences studied should form a basis for understanding the basic and technical nursing that make up the work in the hospital. These sciences are also needed to elucidate and illuminate nursing skills and techniques, many of which involve the use of complicated apparatus and modern scientific concepts (Wilson 1975:1). It is further suggested that the application of relevant knowledge of the biological sciences to nursing practice, is central to skilful practice and a "caring" philosophy. Without such knowledge nurses are unable to deliver safe, high-quality care and in addition "handmaiden status" is perpetuated (Trnobranski 1993:497).

2.2.3 Research findings on the integration of theory-practice in nursing

In discussing the difficulties experienced by nursing students in transferring classroom learning to clinical practice, Wong (1979:161) states that ideal transfer is possible. Students need to be committed to the belief that particular facts learnt in the classroom are pertinent to the other practical situations.

Henderson (1982:57) cites Alexander's (1980) experimental research conducted in the traditional college of nursing/hospital based programme by involving 96% of student nurses in Scotland prepared for registration as nurses. The main aim was to facilitate the integration of theory and practice in nursing. A topic was selected from the General Nursing Council for Scotland syllabus. In this case it was the care of patients with conditions of the gastro-intestinal system.

Student nurses in the experimental group spent part of the allotted time in the wards under the supervision of their tutor from the college, giving total nursing care to patients who had been chosen because their conditions related directly to the subject matter of the course. For the remaining time, the students returned to the college to participate with the same tutor in a seminar in which they discussed the nursing care they had given relating it to their patients' needs and the relevant study material. While this was going on for the experimental group of students, their classmates who were in the control group were taught the same subject matter, but only in college without exposing them to the clinical care of patients suffering from gastro-intestinal diseases. The control group thus received similar material by means of the more conventional college-based methods.

It was found that the students in the experimental group were more knowledgeable, reflective, innovative and creative than those in the control group. Their approach to teaching and learning followed the didactic principle of active, meaningful, reflective and experiential learning. Students in the experimental group were thus encouraged to relate their background theoretical knowledge to their patients' condition and individual needs (Henderson 1982:66).

2.2.4 Research findings on the application of scientific principles in nursing

McFarlane (1977:266) points to several studies of nursing practice which indicate that very little nursing practice is based on a rational and scientific approach. For example, McFarlane (1977:266) cites Murphy's (1971) attention to the fact that the body of knowledge we have in nursing derives from the transmission of superstition, speculation and the accumulation

of unrationalised experiences. It is a sobering thought that many of the nursing texts for students are prescriptive about nursing practice without any scientific validity other than the sanctification of ritual.

Haoses (1990:12) investigated whether professional nurses understood biophysics and biochemistry principles and were able to apply them in the nursing situation. Questionnaires were distributed among clinical instructors, classroom tutors, professional nurses and student nurses in a Namibian Hospital. An analysis of these questionnaires indicated that professional nurses did not understand these scientific principles and were unable to apply them in the clinical situation.

Novak and Gowin (1984:65) focussed on teaching strategies that developed links between scientific theory and basic nursing skills. They compared a traditional approach to teaching basic nursing skills with an innovative approach using the strategies of vee heuristics and concept maps, that consciously link theory with practice. Vee heuristics identify specific concepts, principles and theories related to basic nursing skills and concept maps teach people how to create schematic drawings of their understanding by organising and linking relevant concepts. These researchers found that student nurses using the innovative approach were better able than those using the traditional approach to link scientific theory to their nursing practice and to integrate learning with nursing practice.

According to Jones (1976:58), student nurses were unaware of the full extent of the scientific basis of their future professional work and as stated earlier in this study, came to see chemistry, physics and other basic sciences requirements as of little relevance to them and as serving primarily to eliminate weaker students from the nursing programme. In chemistry, copies of patient clinical laboratory charts displaying both normal and abnormal values of inorganic materials (sodium, potassium) and organic materials (glucose, cholesterol) were distributed among student nurses to show the relevancy of chemistry. Depending on the actual chart used, the nursing professor was able to draw some fairly definite conclusions from the chart about the patient's condition suggesting what type of illness was exhibited and what type of medical and nursing treatment would probably be indicated. It was immediately

obvious to the students that understanding the structure, nature and behaviour of such materials revealed the scientific base of nursing care. Thus, by focussing the students' attention on these few chemical ions and compounds of undisputed clinical importance, the nursing professor was able to demonstrate the relevance of organic and inorganic chemistry to patient treatment and care.

Caon and Treagust (1993:255) studied a sample of undergraduate nursing students classified as successful or unsuccessful according to their results in the first nursing science examination. The sample was surveyed on the perceived difficulty of their science course. Students in the successful group were the most convinced that the science course was relevant to their nursing intended career. Students in the unsuccessful group were not convinced of the relevance of their science course to nursing nor did they consider that they would be better nurses after studying science. They had a low opinion of their ability in science and perceived their science course as difficult. The key to improving the science performance of these nursing students was to convince them of the relevance of their science course to nursing practice. Having achieved this, the students might then devote the appropriate amount of time to studying the content of their course.

In 1975 Wilson (1975:77) undertook a study of the relevance of biological sciences to nursing for the purpose of investigating

- the extent of staff nurses' (professional nurses') knowledge of the biological sciences
- the pattern of learning of these sciences during student nurse training
- the extent to which professional nurses' and student nurses' knowledge of the biological sciences was related to the activities they carried out in hospital wards
- doctors' expectation of professional nurses

A sample of 532 nurses was drawn from three hospitals: 115 professional nurses, 136 third-year, 143 second-year and 138 first-year students. They completed the science test and an intelligence test and provided information about their general education. A postal questionnaire, based on the same nursing activities was completed by a sample of 179

doctors from the same three hospitals. Wilson (1975:77) found that

- the professional nurses did not know how biological sciences related to nursing activities
- the doctors expected professional nurses to have more knowledge of biological sciences than they demonstrated
- the mass of theory which student nurses are expected and assumed to absorb is ill defined, that they are taught this knowledge and how to apply it in the clinical situation in an apparently unstructured and haphazard way

In 1991 Courtenay (1991:1110) studied the teaching and learning of the biological sciences in nurse education in an attempt to identify why some student nurses fail to apply the theory in practice. A questionnaire was used to canvass the views of all third-year student nurses (n = 140) and all nurse teachers (n = 43) from three schools of nursing on the biological sciences in nurse education.

Courtenay found that:

- The balance between the behavioural and biological sciences in nurse education was perceived by the students as being too much in favour of the behavioural sciences.
- Student nurses regarded the level of knowledge of the biological sciences taught as inappropriate for registered general nurse training.
- Teachers felt inadequately prepared to teach the biological sciences and student nurses similarly felt inadequately prepared in these sciences.
- Student nurses considered self-directed methods of teaching and learning as the most ineffective.

Courtenay (1991:1110) also cites unpublished research of Nolan done in 1973. While investigating teaching methods, Nolan found that student nurses found biology easier to learn when practical and discovery teaching methods were used.

Jordan and Reid (1997:169-179) studied practical concerns over curriculum development in nursing. The applied physiology component of a post-registration nursing diploma was evaluated in terms of its impact on patients rather than on the nurses themselves. In 1991-1992, 52 nurses from various clinical settings, studying for the post-registration diploma, collaborated in this study. As a method of data collection the nurses compiled academic diaries of incidents as an assignment over six months where the knowledge gained in the applied physiology course had resulted in improved patient care, together with an exploration of the rationale for their nursing actions. Semistructured interviews and questionnaires were used to the issues raised by the diaries and the question of deployment of knowledge. A representative subsample of 10 nurses was interviewed after the course, and five nurses were reinterviewed six months later. A questionnaire was administered to the whole sample before and after the course. The views of other observers were also sought. Incidents were reported in the academic diaries where course content had led to improved patient care by direct interventions, increased monitoring or patient teaching. The interventions reported by the nurses were closely related to the academic content and applications of knowledge suggested in the lessons. The researchers found that, on this course, diploma level applied physiology impacted positively on nursing practice, resulting in successful management of dehydration, oedema, nutritional deficiency and other conditions (Jordan & Reid 1997:176).

2.3 STUDY FRAMEWORK

2.3.1 Meaningful learning

Akinsanya, a British nursing researcher and theorist, believes strongly in the importance of understanding the sciences as a basis for nursing practice. Meaningful learning, however, is important to achieve this. Learning is meaningful if it allows students to reproduce what they have learnt with understanding at some future date. Thus what nursing students learn in the classroom becomes meaningful and effective if it can be applied at a later stage in their learning experiences in the wards. As students begin to learn basic nursing skills, prior knowledge of physics, anatomy, chemistry and physiology is "fundamental to their understanding and practice" (Akinsanya & Hayward 1980:428).

2.3.2 Meaningful learning defined

Meaningful learning is defined as a process of consciously integrating new knowledge with previous knowledge in ways that strongly link the two (Smith 1992:17). According to Greaves (1987:76), learning is more meaningful and proceeds more effectively if students understand what they are learning and are capable of transferring this learning to their learning experiences. Therefore teachers must really teach for meaning and learning experiences should seek to develop meaning (Greaves 1987:79).

Since professional nursing's body of knowledge is based on knowledge from the human and natural sciences, it is imperative for student nurses, who are learning basic nursing skills, to recall, understand and build on their prior knowledge of these sciences. Meaningful learning therefore involves the acquisition of new meaning that allows learners to relate and anchor new material to their cognitive structure to integrate the essence of new experiences with existing patterns (Curzon 1985:63). Ausubel's learning theory emphasises meaningful learning.

2.3.3 Ausubel's learning theory

Ausubel points out that for material to be learnt meaningfully, it should meet three criteria:

- In meaningful learning the student must adopt a set pattern to learn the task in a meaningful way.
- The learning task itself must have logical meaning in that it can be related to the student's own cognitive structure in a sensible way. This cognitive structure is said to provide anchorage for the new information with both components being modified in the process of assimilation.
- The student's own cognitive structures must contain specifically relevant ideas with which the new material can interact (Quinn 1995:67).

Ausubel, Novak and Hanesian (1978:160) state that most meaningful cognitive learning

occurs as a result of interaction between new information that individuals acquire and the specifically relevant cognitive structures that they already possess. This interaction results in the assimilation or incorporation of both the new and the existing information to form a more detailed cognitive structure (Quinn 1995:67).

Ausubel et al (1978:41) is thus of the opinion that symbolically expressed ideas are related in non-arbitrary and substantive fashion to what the learner already knows.

This can be illustrated with an example: Boyles' law states that the volume of a given mass of a gas is inversely proportional to pressure if temperature is kept constant. This law can only be meaningful if students know the meaning of the following concepts: *volume*, *pressure*, *temperature*, *direct* and *inverse proportions*. Students should relate Boyles' meaning of these concepts when nursing patients on ventilators. When the volume of air is increased in the thoracic cavity, pressure will increase and thus the danger of the complication of barotrauma increases. It is thus essential to set the volume in such a way that the patient will receive the correct volume of air of the ventilator that will not cause barotrauma.

Ausubel (1968:40) further suggests that relevant ideas present in learners' cognitive structure serve as a framework within which they handle similarities and differences encountered in new information. For example, when Ohm's law is taught which states that for a constant electromotive force, the electric current is inversely proportional to the resistance (Jaros & Breur 1991:176). This law will not be meaningfully learnt unless the student already has meanings for the concepts electric current, electromotive force, resistance, inverse and direct proportion and unless she tries to relate these meanings as indicated by Ohm's law in her nursing activities and procedures (Ausubel et al 1978:41). According to this theory, learners accumulate more knowledge either by subsuming new information into their existing cognitive structure or by modifying the structure to accommodate the information. Novak and Gowin (1984:7) concur, adding that to learn meaningfully, individuals must choose to relate new knowledge to relevant concepts and propositions they already know. Ausubel (1968:46) warns that in meaningful learning the materials are only potentially meaningful,

that is, in most potentially meaningful learning tasks, the component parts of the material are already meaningful but in these instances the task as a whole is only potentially meaningful. For instance, in learning Boyles' law, each of the component concepts (volume, pressure, temperature, inverse proportion) is already meaningful but the learning task as a whole is yet to be accomplished in the substantive application of these concepts in their learning experiences in the ward.

2.3.4 Active involvement of students and meaningful learning

For meaningful learning to take place, learners must combine thinking, feeling, perceiving and behaviour. Learners must actually experience the situation personally and holistically (Mashaba & Brink 1994:153). Learning thus becomes meaningful when learners are actively involved and take responsibility for doing so. Meaningful learning requires a deliberate effort on the part of learners to relate new knowledge to relevant concepts they already possess. To facilitate this process, both teacher and student, if they are to proceed efficiently in meaningful learning, need to know the conceptual starting point. The conceptual starting point is what learners already know (Novak & Gowin 1984:10). Thus nursing educators prefer using the knowledge already at hand more effectively than increasing the amount of knowledge. They seek to bring together and connect (integrate) the different disciplines. This is a way of using present knowledge more effectively (Yura et al 1986:225).

2.3.5 The importance of reflection in meaningful learning

Active involvement in a situation is not sufficient for meaningful learning to take place. A time for reflection is a vital part of the process. The integration of new experience with past experience through the process of reflection is thus essential. When reflecting, individuals make a systematic examination of their experience and try to make sense of it all. Individuals are attempting to clarify the meaning of the experience and begin to realise how the information generated by the activity might be useful in future experience (Mashaba & Brink 1994:153). For example, when learning about oedema, students may be allocated to a ward where there are patients presenting with oedema and perhaps also with dehydration.

Students can experience what oedema and dehydration look and feel like. This is then followed by the phase of reflective observation where the students should give similarities and differences between the two. Experiencing and reflecting without transforming the information obtained into a usable tool will seldom bring about meaningful learning. Learners have to analyse the idea they obtained by reflection and come to a conclusion by consulting their textbooks. In this way they can find out more about physiology, chemistry, physics and pathology for proper care of oedematous legs in everyday life.

2.3.6 Meaningful learning versus rote learning

Meaningful learning processes yield superior learning outcomes because they give rise to stable learning. Material which can be learnt via meaningful ways are learnt more rapidly and remembered better than those learnt by rote, since material learnt by rote is not connected with existing knowledge (Woolfolk 1987:277).

Learning should therefore occur meaningfully for student nurses to acquire the necessary knowledge of scientific principles in their cognitive structure to perform all the basic and technical nursing actions and procedures.

2.3.7 Meaningful learning and the scope of practice regulation (R2598)

The scope of practice regulation (R2598) refers to the regulation describing the actions a nurse must be able to perform when registered in the Republic of South Africa (SANC 1984:1-6). To show how meaningful learning can be facilitated, the principles of the scope of practice are related to the learning experiences and to the relevant concepts in biophysics and biochemistry in tabulated form.

Table 2.1: The relation between the scope of practice, selected learning experiences, biophysics and biochemistry (specific item in the scope of practice indicated between brackets)

NO	SCOPE OF PRACTICE	SELECTED LEARNING EXPERIENCES	BIOPHYSICS	BIOCHEMISTRY
1	The administration of medicine (item C)	Administration of medicine	Measurement of dosage	Solutions Suspensions Emulsions
2	Monitoring of patient's vital signs (item C)	Taking and recording temperature, pulse rate, respiratory rate, blood pressure	Measurement Heat and temperature Pressure Boyles' and Pascal's law	Elements Mercury Oxygen Carbon dioxide
3	The facilitation of body mechanics and prevention of body deformities (item G)	Elevation of swollen limbs Exercise of weak limbs in water	Gravitational force Archimedes' principle	
4	Supervision over and maintenance of a supply of oxygen (item H)	Administration of oxygen using various methods	Measurement Volume Pressure Humidity Diffusion	Oxygen Carbon dioxide Water vapour
5	Supervision over and maintenance of fluid, electrolyte and acid base balance (item I)	Intravenous therapy Intake and output	Gravitational force Measurement	Solutions: Isotonic Hypertonic Hypotonic Electrolytes Acids Bases
6	The facilitation of healing of wounds and fractures, the protection of skin ... (item J)	Wound dressing Wound irrigation Prevention of pressure sores Change of position Traction	Gravitational force Pressure Pascal's law Newton's third law of motion levers	Isotonic solution, eg normal saline
7	The facilitation of the maintenance of nutrition of a patient (item L)	Intravenous therapy Insertion of nasogastric tube Nasogastric feeding Recording of intake and output	Gravitational force Friction force Heat and temperature Energy Measurement	Solutions Nutrients Fat Proteins Carbohydrates Vitamins Electrolytes Water

NO	SCOPE OF PRACTICE	SELECTED LEARNING EXPERIENCES	BIOPHYSICS	BIOCHEMISTRY
8	The supervision over and maintenance of elimination by a patient (item M)	Urinalysis Dialysis: Peritoneal and haemodialysis Urinary catheter care Giving of enema Recording of intake and output	Physical properties of urine, ie colour, amount pH, specific gravity Diffusion, osmosis, filtration Gravitational force Pressure Measurement Friction force Heat and temperature Measurement	Chemical properties of glucose, ketones, albumin, etc Isotonic and hypertonic solutions Dialysing solution

2.4 CONCLUSION

Literature was extensively reviewed. Recent research as well as textbooks on which biological sciences are applied in nursing practice and education were consulted. Application of biophysics and biochemistry principles to selected learning experiences was related to the scope of practice in a tabulated form.

CHAPTER 3

Research methodology

3.1 INTRODUCTION

This chapter deals with the research design, population, instrument and procedures for data collection. According to Polit and Hungler (1991:488), scientific readers need to know what was done to collect and analyse relevant data to solve scientific problems. Researchers should approach the problem in a specific goal-directed manner while average people solve their problems through trial and error. The latter method is unsuitable for research as it is not based on theory and frequently operates at a financial loss (Uys & Basson 1985:41).

3.2 RESEARCH DESIGN

The research design is the heart of the research report. It contains all the essential information on strategy and methodology and describes the instrument. A research design is a scheme of action (framework) for answering the research question or questions.

The purpose of the study is to determine whether the professional nurses in surgical units are able to help student nurses apply principles of biophysics and biochemistry in their learning experiences. As this study is descriptive and non-experimental in nature, the survey approach was used. A descriptive survey was employed as a method to provide insight into the situation. Treece and Treece (1986:176) and Polit and Hungler (1991:192) indicate that the term "survey" applies to research in which data is gathered about characteristics, opinions or intentions of a population. It is generally accepted that a descriptive survey may be guided by research questions and/or research objectives. According to Polit and Hungler (1991:144), most research that can be classified as descriptive proceeds without an explicit hypothesis. This study was guided by the research objectives and questions stated in the first chapter.

The survey methods was chosen for the following reasons:

- It provides data about the present and tells what people are thinking, anticipating, planning and doing.
- It enables researchers to be creative in determining the area to be surveyed.
- It is useful for gaining new insight, finding new methods and pointing out the typical or average response.
- It makes it easy for researchers to get information from small or large populations in a relatively economical manner and survey research can be surprisingly accurate (LoBiondo-Wood & Harber 1990:168).

3.3 RESEARCH POPULATION

The research population for this study consisted of two groups, namely stage II student nurses and professional nurses allocated to the surgical units of the four hospital satellite campuses of a nursing college in Gauteng.

Table 3.1: Distance from the main campus college to the four hospital satellite campuses

CAMPUS	DISTANCE
Hospital A	60 km
Hospital B	Within the college premises
Hospital C	60 km
Hospital D	68 km

3.3.1 Student nurses

The student nurse population refers to stage II student nurses training at a nursing college for the diploma for registration with the South African Nursing Council as a nurse (general, psychiatry, community) and midwife. Most of the student nurses were from a disadvantaged educational background. As stated before student nurses registered with this college receive their learning experiences in four hospital satellite campuses or provincial hospitals.

The student nurses were targeted as part of the population because they were almost through with the biophysics and biochemistry syllabi and were supposed to be integrating these scientific principles and concepts with different subjects such as physiology, medical and surgical nursing science and community health nursing science. After they had internalised that knowledge, they were expected to apply it in their learning experiences while working/doing practica in the surgical unit.

Table 3.2: Total number of stage II student nurses per campus

CAMPUS	NUMBER OF STUDENTS	PERCENTAGE
Hospital A	19	13,3
Hospital B	37	26,0
Hospital C	51	35,9
Hospital D	35	24,6
TOTAL (n)	**142**	**100,0**

3.3.2 Professional nurses

Professional nurses from the surgical units were included in this study because they are expected to guide the student nurses in the application of the scientific principles in their learning experiences.

Secondly, by virtue of their teaching and supervisory role, the student nurses regard the professional nurses as mentors and role models.

Table 3.3: Total number of professional nurses allocated to the surgical units at the satellite campuses

CAMPUS	NUMBER OF PROFESSIONAL NURSES	PERCENTAGE
Hospital A	12	18,7
Hospital B	14	21,8
Hospital C	22	34,3
Hospital C	16	25,0
TOTAL (n)	**64**	**100,0**

3.4 SAMPLING METHOD

Accidental sampling was used for both the student nurses and the professional nurses. Accidental samples are inexpensive, accessible and usually require less time to acquire than other types of samples. Subjects are included in the study because they happen to be in the right place at the right time (Burns & Grove 1993:245). Although accidental sampling is the weakest form of sampling, in cases in which the phenomena are fairly homogeneous within the population, the risk of bias may be minimal (Polit & Hungler 1991:257). In this case, the stage II student nurses is a homogeneous group and the group of professional nurses is also a homogeneous group.

Questionnaires were distributed to student nurses and professional nurses who were on duty in the surgical units during a specific day. To eliminate bias, it was important to distribute all the questionnaires at the same time in one venue. The content of the questionnaire could have influenced the respondents, especially the professional nurses, to be more aware of the teaching and application of the scientific principles than is usually the case.

3.4.1 Sampling: student nurses

As mentioned, in the case of student nurses accidental sampling was used. This sampling technique was appropriate because the researcher could only go to one hospital at a time to distribute questionnaires.

Although accidental sampling is used, there is an element of randomisation present because student nurses cannot choose where they want to be allocated at specific times. They are allocated to a clinical area suitable for both the college and campus hospital. All the student nurses have to rotate through all the different clinical areas during their training in order to meet the training objectives of the South African Nursing Council. So each one has an equal chance to be in the surgical area at a specific time.

The researcher tried to distribute questionnaires to at least half the student nurses working

in the surgical units at the time of the study. At the time the questionnaires were distributed the total number of stage II student nurses on day duty in the four hospitals was 33. Of these student nurses, 21 received questionnaires, which is 64%.

Table 3.4: Distribution of questionnaires to student nurses according to hospitals

HOSPITAL	STUDENT NURSES ALLOCATED	STUDENT NURSES AVAILABLE TO RECEIVE A QUESTIONNAIRE
A	6	3
B	9	5
C	13	9
D	7	4

3.4.2 Sampling: professional nurses

In the case of the professional nurses accidental sampling was also used. The researcher tried to obtain a sample size of half of the 64 available subjects. For reasons like sick leave and night duty, the questionnaire could only be distributed to 28 professional nurses, which is 44% of the population.

Table 3.5: Distribution of questionnaires to professional nurses according to hospitals

HOSPITAL	PROFESSIONAL NURSES ALLOCATED	PROFESSIONAL NURSES AVAILABLE TO RECEIVE A QUESTIONNAIRE
A	12	5
B	14	6
C	22	9
D	16	8

3.5 INSTRUMENT VALIDITY

According to Brink (1996:167), instrument validity refers to "whether an instrument accurately measures what it is supposed to measure, given the context in which it is applied". Face validity was established because the questionnaire schedule was presented to four nurse educators. Two were from a college and two from a clinical area (clinical instructors). These nurse educators were asked to check for ambiguity, language, wording, confusing statements and to ensure content validity. They made recommendations which were attended to.

Content validity of the questionnaire was established through the literature study as well as presenting this tool to experts. Lecturers of a university responsible for nursing care and applied biophysics and biochemistry were asked to evaluate the questionnaire.

Criterion-related validity could not be established as another similar, valid instrument could not be found. As construct validity is useful mainly for measures of traits or feelings (Brink 1996:170), and as the instrument was not used by several people over a period of time, it was not established.

3.6 RELIABILITY

The instrument was presented to all the respondents under the same circumstances at the four hospital satellite campuses. They then had time to complete it, and it was collected immediately after it was completed. It was not possible to determine the stability of the instrument as the instrument itself might have caused changes - professional nurses might have been more aware of the application of biophysics and biochemistry after completing the questionnaire. Because similar instruments could not be found, equivalence reliability of the instrument could not be determined.

3.7 RESEARCH INSTRUMENT

In a descriptive survey self-reported information can be obtained from individuals in the sample by means of questionnaire which can either be handed or posted to them (Polit & Hungler 1991:193; Treece & Treece 1986:178). A questionnaire was handed to the respondents.

Polit and Hungler (1991:293) points out that the specific advantages of using a questionnaire are:

- It is a rapid and efficient method of gathering information.
- Measurement is enhanced because all subjects respond to the same questions.
- Respondents are kept anonymous.

3.7.1 Construction of questionnaires

The construction of a questionnaire requires thought, planning and testing. Researchers must convince and motivate respondents and give them clear written instructions to understand and respond properly to the questions or statements. Researchers should therefore formulate clear unambiguous questions, arrange them in the proper order and organise the questionnaire to make collecting data from it as easy and accurate as possible (Seaman 1987:27). In drawing up the questionnaires for this study, the researcher also consulted Akinsanya (1987:272), Haoses (1990:192) and Polit and Hungler (1991:286-293). English was used because professional nurses and student nurses were comfortable with English. Two questionnaires were developed:

- Questionnaire A, directed to stage II student nurses (annexure B).
- Questionnaire B, directed to professional nurses (annexure C).

Both questionnaires comprise of the following elements:

➤ **Covering letter**

This is attached to the front of each questionnaire. It explains and clarifies the purpose of the research and guarantees anonymity and confidentiality to the respondents. It is valuable for gaining cooperation, introducing the questionnaire and the researcher to the respondents (annexures B and C).

➤ **Instruction to the respondents**

Instructions are given throughout each questionnaire to enable the respondents to make appropriate responses.

➤ **Questions or statements (items)**

The questions or statements to which the respondents had to respond were based on applied biophysics and biochemistry principles, procedures/activities in the surgical unit as well as the role of the professional nurses and the student nurses in application of these scientific principles in the learning experiences of student nurses in the surgical unit. In the rest of this chapter as well as chapter 4 these statements requiring a response and the questions are all called items.

3.7.2 Content of questionnaires

3.7.2.1 Questionnaire A (directed to student nurses)

➤ **Student nurses' participation**

In item 1 the researcher wished to determine whether the student nurses were involved in the formulation of the clinical teaching learning programmes and whether the programme

objectives were related to applied biophysics and biochemistry. Haoses (1990:212) advocates that the broad framework of the clinical-teaching programme be given to student nurses.

➤ **Learning objectives**

Item 2 investigates whether the general and specific objectives of applied biophysics and biochemistry are indicated or explained to student nurses before a lecture demonstration or clinical teaching. Student nurses should know what they will achieve after the successful completion of the procedure. The very specific objectives are the yardsticks to check whether student nurses have reached their goals.

➤ **Applied biophysics and biochemistry**

Item 3 investigates whether the importance of applied biophysics and biochemistry is emphasised in the student nurses' learning experiences. The researcher is of the opinion that biophysics and biochemistry form the foundation of nursing science. If student nurses do not see the relevance of these sciences to nursing practica, they will not be motivated to study or apply them and will not understand why these subjects should be included in their curriculum.

➤ **Integration of biophysics and biochemistry with other subjects**

Item 4 investigates whether the relationship between biophysics and biochemistry and other nursing subjects is indicated to student nurses. The integration of biophysics and biochemistry with other nursing subjects, such as anatomy, physiology, nursing science and art, and community health nursing science, will break down barriers between subject areas and bring essential areas of the curriculum together. This integration will also assist student nurses to assimilate and apply scientific concepts/principles from appropriate disciplines in their learning experiences in the ward.

Item 5 investigates whether the procedures or activities in the ward are linked to biophysics and biochemistry. As stated in item 3, student nurses will not understand the relevance of these subjects if they are not made aware of it. Specific examples are mentioned in items 7 to 14 to evaluate whether the scientific principles or concepts are related to nursing procedures and activities.

➤ **Continuous evaluation**

Item 6 investigates whether the specific objectives of biophysics and biochemistry form part of a continuous evaluation tool for student nurses in the surgical unit. All the subjects and content making up the course should be included, otherwise student nurses will not be able to see why certain subject matter should be included, if they are not evaluated on it.

➤ **Specific examples from biophysics and biochemistry which could be applied in the surgical unit**

The questionnaire aimed to establish to what extent some principles are applied by asking questions on specific examples from biophysics and biochemistry which could be applied in the surgical unit in items 7 to 14.

Item 7 investigates whether Pascal's law is pointed out or explained to student nurses when taking (measuring) blood pressure.

Item 8 investigates whether Newton's third law, which states that to every action there is an equal and opposite reaction, is pointed out to student nurses when nursing a bedridden unconscious patient with pressure sores.

Item 9 investigates whether the importance of humidity is pointed out to student nurses when oxygen is administered since dry oxygen irritates the upper respiratory tract mucosa.

Item 10 investigates whether the physical and chemical properties of urine are pointed out to student nurses when testing urine. If physical or chemical abnormalities are detected, this can help student nurses to understand the pathophysiology of the kidneys and to formulate a nursing diagnosis.

Item 11 investigates whether specific reasons for high specific gravity are highlighted to student nurses when nursing an unconscious patient with diminished dark urine, which signifies that the patient is not getting enough fluids, which may lead to dehydration.

Item 12 investigates whether the reasons for putting the urine bag at low levels when nursing a patient with a urinary catheter *in situ*, in this case gravitational force, are explained to student nurses.

Item 13 investigates whether the reason (viz gravitational force) for raising the intravenous drip set above the patient's level during intravenous therapy is explained to student nurses.

Item 14 investigates whether different solutions and their chemical effects are explained to student nurses during wound irrigation because each solution has its own specific pharmacological or chemical effect on a wound.

➤ **Open-ended questions**

The first question the student nurses are asked is to indicate nursing activities/procedures that involve the application of biophysics and biochemistry that they could initiate independently of medical prescription. Procedures that can be initiated without medical prescription are those which are within their scope of practice. The researcher anticipated that examples the student nurses could include were ones that do not appear in the questionnaire to assess their broader knowledge in the application of biophysics and biochemistry principles.

The second question goes further to ask whether they are motivated to do so, interested in doing so and to give reasons for their answer. The researcher is of the opinion that student

nurses will only be motivated if they see the relevance of scientific principles to nursing care.

3.7.2.2 Questionnaire B (directed to professional nurses)

➤ **Problems experienced by professional nurses in the application of biophysics and biochemistry in the learning experiences of student nurses**

Item 1 investigates whether professional nurses feel that they do lack adequate knowledge of the life sciences (biophysics and biochemistry). In the researcher's view, if they feel that they lack scientific knowledge, they will not be confident enough to teach student nurses the application of these sciences in the clinical situation.

Item 2 asks whether the professional nurses have problems in simplifying scientific concepts. This question was necessary because if they do have problems, to be able to teach student nurses, it is their responsibility to seek knowledge or keep abreast by attending in-service training where these sciences are taught and applied.

Item 3 investigates whether the professional nurses have to rely on the medical staff and tutors to explain scientific aspects of nursing care. This question could also indicate whether they lack the scientific knowledge to impart to student nurses.

Item 4 investigates whether the professional nurses have difficulty in identifying procedures or activities in the surgical units in which these scientific concepts can be applied. The reason for including this question is that if they are unable to identify procedures where these scientific principles can be applied, correlation of these sciences cannot take place in the ward.

Item 5 goes further to ask whether the professional nurses do have accessibility to a library while in the clinical situation. If accessibility to a library is a problem, it means that the professional nurses who are motivated to help the student nurses, cannot refer to sources to study or reinforce what they are expected to teach.

➤ **View of professional nurses on setting of objectives and involvement of students in formulating teaching programmes**

Items 6 to 11 are similar to 1 to 6 of questionnaire A directed to the student nurses. As in questionnaire A, these items are directed at investigating whether professional nurses involve students in the formulation of objectives and explain the objectives that deal with biophysics and biochemistry to the student nurses. They also determine if the importance of the sciences is emphasised and the relationship between these sciences and other nursing subjects indicated. Item 10 asks if procedures or activities are related to applied biophysics and biochemistry. Item 11 focusses on evaluation and whether the biophysics and biochemistry objectives are used in continuous evaluation.

➤ **Specific examples from biophysics and biochemistry which could be applied in the surgical unit**

Items 12 to 19 are similar to items 7 to 14 of questionnaire A. These items consist of specific examples of nursing actions where biophysics or biochemistry principles can be applied. Respondents have to indicate whether they apply these principles.

➤ **Open-ended questions**

Item 20 investigates how much opportunity professional nurses have in their present job to apply biophysics and biochemistry to the learning experiences of student nurses. This is to determine whether professional nurses are really actively involved in the teaching process.

Item 21 goes further to investigate whether they are motivated to do so and asks them to give reasons for their answer. The reason for including this question is to see if professional nurses are resistant or really willing to do so.

Item 22 investigates what nursing activities that involve the application of biophysics and biochemistry they can initiate independently of medical prescription if they understand the

underlying sciences. The objective is to determine to what extent professional nurses are able to take the initiative in the application of these scientific principles in the nursing activities in their scope of practice. Professional nurses are asked to list the nursing activities and the appropriate scientific principles.

3.8 ETHICAL CONSIDERATIONS

3.8.1 Voluntary participation

Participants are not obliged to participate in the study as one of the principles of ethical conduct in research is that participation in studies should be voluntary (Burns & Grove 1993:94). The purpose and significance of this study was explained to the participants to secure their voluntary consent (Burns & Grove 1993:94; Polit & Hungler 1991:36).

3.8.2 Confidentiality

To protect the respondents' right to privacy and to safeguard participation and their identities, anonymity and confidentiality were ensured by informing them not to write their names or identify themselves in any way (Burns & Grove 1993:99; Polit & Hungler 1991:30; Treece & Treece 1986:131).

It is also ethical to inform respondents exactly what will be done with the results of the study. Subjects must be told why their honest opinion is required. In this case, the purpose of the study was fully explained to student nurses and professional nurses.

3.8.3 Permission for the study

Before data could be collected permission had to be sought.

It would have been violation of Gauteng Province Health Policy to approach hospitals without obtaining authorisation for conducting research from the Director of Hospital Services. A letter requesting permission to collect data from nurses in various satellite campuses was forwarded to the Director. Permission was granted (annexure A).

Permission was granted by superintendents and matrons from Boksburg-Benoni, Natalspruit, Leratong and Sebokeng hospitals. (annexure A). Permission was also granted by the college principal for conducting research (annexure A).

3.9 SUMMARY

This chapter discussed the nonexperimental descriptive survey method. Questionnaires were used to collect data from stage II student nurses and professional nurses allocated to the surgical unit at various hospital campuses in Gauteng Province. These questionnaires were described and discussed. Chapter 4 deals with the analysis of data, findings, implications and recommendations.

CHAPTER 4

Data analysis, findings and recommendations

4.1 INTRODUCTION

This chapter presents and analyses the data obtained from questionnaires A and B for student nurses and professional nurses, respectively. Then the findings are discussed and recommendations made. The two groups in the population were allocated in the surgical units of four hospital satellite campuses.

In the case of questionnaire A, 21 questionnaires were distributed to student nurses, 19 questionnaires were completed and found usable.

In the case of questionnaire B, 28 questionnaires were distributed to professional nurses, 25 questionnaires were completed and found usable.

As the respondents did not have to return the questionnaires by mail but could deliver them to a set point, all the questionnaires either completed or not completed were returned.

4.2 QUESTIONNAIRES ISSUED AND RETURNED

Table 4.1 reflects the difference in response for the two questionnaires according to the two population groups.

Table 4.1: Number of questionnaires issued and returned by two groups in study population

POPULATION	QUESTION-NAIRES ISSUED	QUESTION-NAIRES FOUND NOT USABLE	QUESTION-NAIRES FOUND USABLE	PERCENTAGE OF QUES-TIONNAIRES THAT COULD BE USED
Second-year student nurses	21	2	19	90
Professional nurses	28	3	25	89

Table 4.2 gives a detailed indication of the questionnaires found usable per different hospital campus for questionnaire A.

Table 4.2: Number of questionnaires found usable per hospital satellite campus (questionnaire A)

HOSPITAL	QUESTIONNAIRES ISSUES	QUESTIONNAIRES THAT COULD BE USED
A	3	3
B	5	5
C	9	8
D	4	3
TOTAL (n)	**21**	**19**

Table 4.3 gives a detailed indication of the questionnaires found usable per different hospital satellite campus for questionnaire B.

Table 4.3: Number of questionnaires found usable per hospital satellite campus (questionnaire B)

HOSPITAL	QUESTIONNAIRES ISSUES	QUESTIONNAIRES THAT COULD BE USED
A	5	5
B	6	6
C	9	7
D	8	7
TOTAL (n)	**28**	**25**

4.3 FINDINGS ON QUESTIONNAIRE A

This questionnaire was directed to second-year student nurses allocated to surgical units of four hospital satellite campuses. For each item on the questionnaire the findings are first presented in tabular form and then discussed. In some cases recommendations are made on the findings.

4.3.1 Item 1

The first item investigates whether the respondents are involved in the formulation of the clinical teaching-learning programme. The responses to this question are reflected in table 4.4.

Table 4.4: Involvement of student nurses in the formulation of clinical teaching-learning programme

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	0	0	16%
2	Frequently	3	16	
3	Seldom	7	37	84%
4	Never	9	47	
TOTAL (n)		**19**	**100**	

➤ **Findings**

The majority of student nurses (84%) feel that they are *seldom* or *never* involved in the formulation of the clinical teaching-learning programme whereas 16% feel they are *frequently* or *always* involved. These results imply that the student nurses feel they are not given ample opportunity to plan their own learning and are just passive recipients of learning.

➤ **Recommendations**

Student nurses should form part of the teaching-learning (didactic) environment. They should be made aware that they are important in the planning process. One of the cardinal principles of andragogy is that all concerned with educational enterprise should be involved in its planning (Quinn 1995:105). Ward learning programmes should be introduced which provide systematic learning experiences for learners during their period of allocation to the wards and are acceptable to them.

Knowles' andragogical theory according to Quinn (1995:106), states that students should also be involved in the administration and evaluation of the learning programme.

4.3.2 Item 2

Item 2 investigates whether the specific and general objectives of applied biophysics and biochemistry are explained to the student nurses. The responses to item 2 are reflected in table 4.5.

Table 4.5: Explanation of specific and general objectives of applied biophysics and biochemistry to student nurses

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	3	16	42%
2	Frequently	5	26	
3	Seldom	4	21	58%
4	Never	7	37	
TOTAL (n)		**19**	**100**	

➤ **Findings**

Of the student nurses, 58% indicated that objectives were *never* or *seldom* explained to them while 42% indicated that the objectives were *frequently* or *always* explained to them. This implies that a substantial portion of student nurses do and will not know what they are expected to achieve in the practical situation unless the specific and general objectives are indicated to them. Without specific objectives it is impossible or difficult to evaluate what you have taught because "any statement of the objectives of the school should be a statement of changes to take place in students" (Hawkins 1981:25; Infante 1985:44).

➤ **Recommendations**

All the wards should be provided with a curriculum document, the study guides and modules for each subject where these objectives are spelled out, so that professional nurses and student nurses are clear on the objectives that should be reached. Specific objectives of applied biophysics and biochemistry should form part of the evaluation programme as well as demonstrations and lessons given in the practical situation.

4.3.3 Item 3

Item 3 investigates whether the importance of applied biophysics and biochemistry is emphasised in the learning experiences of student nurses. The responses to item 3 are reflected in table 4.6.

Table 4.6: Emphasis on the importance of applied biophysics and biochemistry in the learning experiences of student nurses

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	8	42	42%
2	Frequently	0	0	
3	Seldom	6	32	58%
4	Never	5	26	
TOTAL (n)		**19**	**100**	

➤ **Findings**

It is encouraging to find that 42% of the student nurses indicated that the importance of applied biophysics and biochemistry is *always* emphasised in their learning experiences

although, sadly, the majority, 58% stated that it is *seldom* or *never* emphasised. This means that in the first place professional nurses should be made aware of the importance of these subjects so that they can indicate it to the student nurses.

4.3.4 Item 4

Item 4 investigates whether the relationship between biophysics and biochemistry and other nursing subjects is indicated to student nurses. The responses to item 4 are reflected in table 4.7.

Table 4.7: Relationship between biophysics and biochemistry and other nursing subjects indicated to student nurses

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	8	42	58%
2 Frequently	3	16	
3 Seldom	3	16	42%
4 Never	5	26	
TOTAL (n)	**19**	**100**	

➤ **Findings**

It seems as if the relationship between biophysics and biochemistry and other nursing subjects is indicated to student nurses generally as 58% of the student nurses indicated that the relationship of these sciences to other nursing subjects is *always* and *frequently* indicated. However, 42% of the respondents indicated that it is *seldom* or *never* done.

➤ **Recommendations**

The importance of indicating the relationship between biophysics and biochemistry and other nursing subjects cannot be overemphasised. Greaves (1987:26) points out that curriculum design experts advocate an organised and integrated curriculum that brings all nursing subjects together to from a unified and meaningful whole.

4.3.5 Item 5

Item 5 investigates whether the procedures/activities in the surgical unit are related to applied biophysics and biochemistry. The responses to item 5 are reflected in table 4.8.

Table 4.8: Relationship of procedures/activities in the surgical unit to applied biophysics and biochemistry

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	7	37	69%
2 Frequently	6	32	
3 Seldom	2	10	31%
4 Never	4	21	
TOTAL (n)	**19**	**100**	

➤ **Findings**

The majority of the student nurses (69%) stated that procedures and activities in the surgical unit are *always* and *frequently* related to applied biophysics and biochemistry. However, 31% of the student nurses indicated that these procedures are *seldom* or *never* related to applied biophysics and biochemistry.

4.3.6 Item 6

Item 6 investigates whether the specific objectives of applied biophysics and biochemistry are used in the continuous evaluation of student nurses in the surgical unit. The responses to item 6 are reflected in table 4.9.

Table 4.9: The use of the specific objectives of applied biophysics and biochemistry in the continuous evaluation of student nurses in the surgical unit

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	1	5	> 10%
2 Frequently	1	5	
3 Seldom	3	16	> 90%
4 Never	14	74	
TOTAL (n)	**19**	**100**	

➤ **Findings**

The majority (90%) of the student nurses indicated that the specific objectives of applied biophysics and biochemistry are *seldom* or *never* used in the continuous evaluation of student nurses in the surgical unit. However, 10% of student nurses indicated that the specific objectives of these sciences were *frequently* or *always* used in their continuous evaluation in the surgical unit.

➤ **Recommendations**

Biophysics and biochemistry form part of the foundation of nursing science subjects and it is therefore recommended that these sciences be included in the continuous evaluation of

student nurses.

4.3.7 Item 7

Item 7 investigates whether the principles that fluids at rest transmit pressure equally and evenly in all directions is explained to student nurses when the blood pressure cuff compresses an artery. The responses to item 7 are reflected in table 4.10.

Table 4.10: Explanation to student nurses of principle that fluids at rest transmit pressure equally and evenly in all directions when blood pressure cuff compresses artery

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	3	16	27%
2	Frequently	2	11	
3	Seldom	4	21	73%
4	Never	10	52	
TOTAL (n)		**19**	**100**	

➤ **Findings**

The majority of the student nurses (73%) indicated that the principle that fluids at rest transmit pressure equally and evenly in all directions (Pascal's law) is *seldom* or *never* applied when student nurses are taught how to take blood pressure. However, 27% of the student nurses indicated that this scientific principle of fluid at rest is *frequently* or *always* applied during blood pressure taking, especially when the blood pressure cuff compresses an artery.

➤ **Recommendation**

For student nurses to understand the principle of blood pressure measuring as well as why patients complain of numbness of the arm if the blood pressure cuff is inflated to a pressure above a certain level that obstruct an artery, it is recommended that Pascal's law be explained whenever blood pressure is taken.

4.3.8 Item 8

Item 8 investigates whether the principle that for every action there is an equal and opposite reaction is related to the development of pressure sores when nursing a bedridden, unconscious, emaciated patient. The response to item 8 is reflected in table 4.11.

Table 4.11: Relation of the principle that for every action there is an equal and opposite reaction to the development of pressure sores when nursing a bedridden, unconscious, emaciated patient

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	9	47	73%
2 Frequently	5	26	
3 Seldom	3	16	27%
4 Never	2	11	
TOTAL (n)	**19**	**100**	

➤ **Findings**

It was found that the majority (73%) of the student nurses indicated that the scientific principle (Newton's third law of motion) is *frequently* and *always* related to the development

of pressure sores when nursing unconscious, emaciated, bedridden patients while the minority (27%) of the student nurses indicated that this principle is *seldom* or *never* related to the development of pressure sores. This is an encouraging finding because Hoeman (1996:280) indicates that pressure is the most important factor in pressure ulcer formation. It is generally agreed that the etiology of pressure ulcers is prolonged, uninterrupted mechanical loading of tissue.

4.3.9 Item 9

Item 9 investigates whether the importance of water vapour (humidity) during the administration of oxygen is indicated to the student nurses. The responses to item 9 are reflected in table 4.12.

Table 4.12: Indication to the student nurses of the importance of water vapour (humidity) during administration of oxygen

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	10	53	84%
2 Frequently	6	31	
3 Seldom	2	11	16%
4 Never	1	5	
TOTAL (n)	**19**	**100**	

➤ **Findings**

The majority (84%) of student nurses indicated that the importance of water vapour during administration of oxygen is *always* or *frequently* indicated to the student nurses while 16% of the student nurses said that the importance of water vapour during the administration of

oxygen is *seldom* or *never* indicated to them. This is also an encouraging finding because oxygen should be moistened by passing it through a humidification system to prevent the mucous membrane of the respiratory tract from becoming dry (Jensen 1982:92; Smeltzer & Bare 1996:545). The oxygen is bubbled through the water and absorbs the required amount of water (Jensen 1982:92).

4.3.10 Item 10

Item 10 investigates whether the physical and chemical properties of urine during urinalysis are explained to the student nurses. The responses to item 10 are reflected in table 4.13.

Table 4.13: Explanation to the student nurses of the physical and chemical properties of urine during urinalysis

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	16	84	89%
2 Frequently	1	5	
3 Seldom	2	11	11%
4 Never	0	0	
TOTAL (n)	**19**	**100**	

➤ **Findings**

Of the student nurses, 89% indicated that the physical and chemical properties of urine during urinalysis are *always* and *frequently* explained to them, while 11% of the student nurses indicated that the physical and chemical properties of urine during urinalysis are *seldom* explained to them. This is an important and encouraging finding because urinalysis tests provide a rapid method of screening symptomatic patients for certain substances,

including haemoglobin, ketones, ph, protein and leucocytes (Smeltzer & Bare 1996:1136).

4.3.11 Item 11

Item 11 investigates whether the specific reasons for high specific gravity are explained to the student nurses when nursing an unconscious patient with diminished dark urine. The responses to item 11 are reflected in table 4.14.

Table 4.14: Explanation to the student nurses of the specific reasons for high specific gravity when nursing an unconscious patient with diminished dark urine

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	7	37	58%
2 Frequently	4	21	
3 Seldom	3	16	42%
4 Never	5	26	
TOTAL (n)	**19**	**100**	

➤ **Findings**

It was found that the majority (58%) of student nurses indicated that the specific reasons for high specific gravity are *always* or *frequently* explained to them when nursing an unconscious patient with diminished dark urine. However, 42% of the student nurses claimed that the reasons for high specific gravity when patients urine is concentrated are *seldom* or *never* explained to them. An abnormally high urine specific gravity indicates a concentrated urine consisting mainly of solute particles with less water particles. This may be due to dehydration causing excessive water retention or from the excessive excretion of a particular substance (Hinwood 1981:45).

4.3.12 Item 12

Item 12 investigates whether the scientific reasons for putting the urine bag at low levels when nursing a patient with a urinary catheter *in situ* are explained to the student nurses. The responses to item 12 are reflected in table 4.15.

Table 4.15: Indication to the student nurses of scientific reasons for putting the urine bag at low levels when nursing a patient with urinary catheter *in situ*

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	10	53	85%
2 Frequently	6	32	
3 Seldom	3	15	15%
4 Never	0	0	
TOTAL (n)	**19**	**100**	

➤ **Findings**

The majority of the student nurses (85%) stated that the scientific reasons for putting the urine bag at low levels when nursing a patient with a urinary catheter *in situ* are *always* and *frequently* indicated to them, while 15% of the student nurses indicated that scientific reasons are *seldom* indicated to them. The bag is never raised above the level of the patient's bladder because this will cause the flow of concentrated urine by gravity into the patient's bladder from the urine bag (Smeltzer & Bare 1996:1151).

4.3.13 Item 13

Item 13 investigates whether the gravitational force is related to raising the intravenous drip

set above the patient's level during intravenous therapy. The responses to item 13 are reflected in table 4.16.

Table 4.16: Relation of gravitational force to raising the intravenous drip set above the patient's level during intravenous therapy

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	13	68	84%
2 Frequently	3	16	
3 Seldom	2	11	16%
4 Never	1	5	
TOTAL (n)	**19**	**100**	

➤ **Findings**

The majority (84%) of the student nurses indicated that the gravitational force is *always* and *frequently* related to raising the intravenous drip set above the patient's level during intravenous therapy. However, 16% of the student nurses indicated that the gravitational force is *seldom* and *never* related to raising the intravenous drip above the patient's level during intravenous infusion. The flow of an intravenous infusion is subject to the same principles that govern fluid movement in general, including that the flow is directly proportional to the height of the liquid column. Raising the height of the infusion container may improve a sluggish flow (Smeltzer & Bare 1996:241).

4.3.14 Item 14

Item 14 investigates whether different types of solutions during wound irrigation are explained to student nurses. The number of responses to item 14 are reflected in table 4.17.

Table 4.17: Explanation to student nurses of different types of solutions during wound irrigation

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	3	16	37%
2	Frequently	4	21	
3	Seldom	4	21	63%
4	Never	8	42	
TOTAL (n)		**19**	**100**	

➤ **Findings**

The majority (63%) of the student nurses indicated that different types of solutions during wound irrigation are *seldom* and *never* explained to them. However, 37% of the student nurses indicated that different types of solutions are *always* and *frequently* explained to them.

➤ **Recommendation**

Different types of solutions, such as isotonic, hypertonic and hypotonic solutions, play an important part in wound irrigation. It is therefore recommended that these solutions be explained to student nurses so that they can know the effects of each solution on the body.

4.3.15 Open-ended questions

4.3.15.1 First open-ended question

Out of the 19 questionnaires that could be used 17 students answered question 1 of the open-ended questions and two student nurses did not answer it.

Table 4.18: Number (n) of student nurses who answered and who did not answer the first open-ended question

STUDENT NURSES	TOTAL (n)	PERCENT
Answered	17	89
Not answered	2	11
TOTAL (n)	**19**	**100**

This question investigates which of the nursing procedures/activities that nurses perform involve the application of biophysics and biochemistry principles and could be initiated by the student nurses independently of medical prescription if they had an appropriate knowledge of the underlying scientific principle. The number of procedures/activities does not correspond with the total number of student nurses who answered this question because most of the respondents gave more than one procedure and some failed to indicate the related scientific principle. In many cases the procedures were the same as indicated in other items of the questionnaire. Table 4.19 reflects the responses to the first question.

Table 4.19: Nursing procedures/activities performed by nurses that involve the application of biophysics and biochemistry principles and could be initiated independently of medical prescription

NURSING PROCEDURES/ACTIVITIES		SCIENTIFIC PRINCIPLE	TOTAL (n)	PERCENTAGE
(1)	Shaking the thermometer before taking the temperature	Centrifugal force on mercury column	6	11,5
(2)	Temperature taking	Heat and temperature	3	5,8
(3)	Taking of blood pressure	Boyles' law, pressure, Pascal's law	6	11,5
(4)	Urinalysis	Chemical and physical properties of urine	7	13,5
(5)	Urinary catheterisation	Friction force	1	1,9
(6)	Raising the intravenous drip above the patient's level	Gravitational force	5	9,6

NURSING PROCEDURES/ACTIVITIES		SCIENTIFIC PRINCIPLE	TOTAL (n)	PERCENTAGE
(7)	Intravenous infusion	Different types of solutions	5	9,6
(8)	Elevating oedematous legs	Gravitational force	1	1,9
(9)	Postural drainage	Gravitational force	1	1,9
(10)	Putting the urine bag at low levels when nursing patient with urinary catheter *in situ*	Gravitational force	3	5,8
(11)	Putting the intercostal drainage bottle at low levels	Gravitational force	2	3,9
(12)	Pushing the patient in a wheelchair	Newton's first and second laws of motion	2	3,9
(13)	Administering injections	Pressure, solutions, osmosis	1	1,9
(14)	Calculation of medicine doses	Measurement	1	1,9
(15)	Administering medicines	Solutions, suspensions, emulsions, colloids	1	1,9
(16)	Wound irrigation	Different types of solutions	3	5,8
(17)	Administration of oxygen	Humidity, oxygen element	3	5,8
(18)	Changing the patient's position	Pressure: Newton's third law of motion	1	1,9
TOTAL RESPONSES (n): 18			**52**	**100,0**

➤ **Findings**

Eighteen different responses were listed. Out of all the questionnaires a total of 52 responses were recorded. Table 4.19 indicates the frequency and percentage of the responses. The respondents did not use a lot of their own initiatives, as many of the listed responses are the same as previously asked in the questionnaire.

4.3.15.2 Second open-ended question

The second open-ended question asks whether the student nurses are interested in or motivated to apply biophysics and biochemistry principles when performing nursing procedures/activities in the surgical unit and to give reasons for their answer. The responses to the second question are reflected in table 4.20.

Table 4.20: Student nurses' interest in and motivation for applying biophysics and biochemistry principles when performing procedures in the surgical unit

RESPONSES	TOTAL (n)	PERCENT
Yes	19	100
No	0	0
TOTAL (n)	**19**	**100**

➤ **Findings**

The results indicate that 100% of the student nurses are interested in and motivated to apply the scientific principles when performing procedures in the surgical unit. The reasons the respondents answered *yes* to this question are reflected in table 4.21.

Table 4.21: Reasons why the respondents answered *yes* to this question

REASONS FOR *YES*		TOTAL (n)	PERCENT
(1)	Biophysics and biochemistry are related to nursing	2	8,3
(2)	For a better understanding of the procedure	2	8,3
(3)	Prevention of pressure sores	1	4,2
(4)	To increase their knowledge and application of these scientific principles	1	4,2
(5)	Integration of theory and practice	3	12,5
(6)	Detection of urine abnormalities	1	4,2
(7)	For accuracy in measurement	1	4,2
(8)	Prevention of medico-legal hazards	4	16,6
(9)	Rationale for performing nursing procedures	6	25,0
(10)	To provide total nursing care	3	12,5
TOTAL (n) OF REASONS = 10		**24**	**100,0**

➤ **Findings**

Ten different reasons were listed. Of all the questionnaires a total of 24 responses was recorded. The total number of student nurses (19) does not correspond with the total number of responses (24) because some respondents give more than one reason for an answer. Table 4.21 indicates the frequency and percentage of the responses.

➤ **Recommendations**

With regard to the teaching, learning and application of the life sciences in nursing education it is important to define, structure and progressively organise the life sciences base of student nurses' knowledge for practice clearly throughout their training. A distinctive theoretical framework which links nursing directly to life sciences, should be developed (Akinsanya 1987:270).

4.4 FINDINGS ON QUESTIONNAIRE B

This questionnaire was directed to the professional nurses allocated in the surgical unit of four hospital satellite campuses. For each item on the questionnaire the findings are firstly presented in tabular form and then discussed. In some cases recommendations are made on the findings.

4.4.1 Item 1

Item 1 investigates whether the respondents lack adequate knowledge of the life sciences biophysics and biochemistry. The responses to item 1 are reflected in table 4.22.

Table 4.22: Lack of adequate knowledge of the life sciences biophysics and biochemistry

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Strongly agree	1	4	44%
2	Agree	10	40	
3	Disagree	6	24	56%
4	Strongly disagree	8	32	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority of the professional nurses (56%) *disagree* and *strongly disagree* that they lack adequate knowledge of the life sciences biophysics and biochemistry while 44% of them *agree* or *strongly agree* that they lack adequate knowledge of biophysics and biochemistry.

➤ **Recommendations**

All the professional nurses in this study are in a position to teach/apply the principles of biophysics and biochemistry. Professional nurses need to be kept abreast of biochemistry and biophysics by

- in-service training
- involvement in research projects, workshops and symposia where these sciences are revised, learned and applied
- involvement in curriculum development and continuous evaluation of student nurses in the clinical area where these scientific principles are applied

4.4.2 Item 2

Item 2 investigates whether the professional nurses have problems with simplifying scientific concepts. The responses to item 2 are reflected in table 4.23.

Table 4.23: Professional nurses having problems with simplifying scientific concepts

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Strongly agree	4	16	52%
2 Agree	9	36	
3 Disagree	4	16	48%
4 Strongly disagree	8	32	
TOTAL (n)	**25**	**100**	

➤ **Findings**

The majority (52%) of the professional nurses *strongly agree* and *agree* that they have problems with simplifying scientific concepts. However, 48% of them *disagree* and *strongly disagree* that they have problems with simplifying scientific concepts.

➤ **Recommendations**

As the professional nurses working in the surgical unit are in a position to teach they should communicate with classroom tutors teaching biophysics and biochemistry, in order to get ideas on how to do so. Classroom tutors should also accompany student nurses in the clinical area to ensure that what they have taught in the classroom is applied in the learning experiences of student nurses. Professional nurses should be given the opportunity to do short courses or in-service training in biochemistry and biophysics and their application.

4.4.3 Item 3

Item 3 investigates whether the professional nurse have to rely on the medical staff and tutors to explain scientific aspects of nursing care. Responses to item 3 are reflected in table 4.24.

Table 4.24: Professional nurses' reliance on medical staff and tutors to explain scientific aspects of nursing care

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Strongly agree	2	8	> 52%
2	Agree	11	44	
3	Disagree	6	24	> 48%
4	Strongly disagree	6	24	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (52%) of the professional nurses *agree* and *strongly agree* that they have to rely on the medical staff and tutors to explain scientific aspects of nursing care, while 48% of them *strongly disagree* and *disagree* that they rely on medical and tutorial staff to explain scientific principles. This implies that most of the professional nurses still rely on medical staff to explain the scientific aspects of nursing care. According to Akinsanya and Hayward (1980:427), professional nurses should distinguish between nursing care and medical care. Nursing deals with nursing aspects of patient care based on biological sciences whereas medical care emphasises pathology, medical diagnosis and treatment.

➤ **Recommendations**

Professional nurses should rely on tutorial staff to explain scientific aspects of nursing care. Akinsanya and Hayward (1980:432) advocate specialisation by teachers of nurses in specific subject areas of biological sciences as a helpful development in nursing education. Another possibility is for teachers who successfully teach biological sciences to nurses to share their expertise widely with other teachers (Clarke 1995:406). A distinction should be made between the nursing and medical models. Nursing education, practice and research should be situated firmly within the nursing model (Akinsanya & Hayward 1980:427).

4.4.4 Item 4

Item 4 investigates whether the professional nurses have difficulty in identifying procedures or activities in the surgical unit in which scientific concepts are applied. Responses to item 4 are reflected in table 4.25.

Table 4.25: Difficulty in identifying procedures or activities in the surgical unit in which scientific concepts are applied

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Strongly agree	3	12	> 60%
2	Agree	12	48	
3	Disagree	8	32	> 40%
4	Strongly disagree	2	8	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (60%) of the professional nurses *strongly agree* and *agree* that they do have problems in identifying procedures or activities in which scientific principles are applied. However, 40% of the professional nurses *disagree* and *strongly disagree* that they have difficulty in identifying procedures/activities where scientific principles are applied.

➤ **Recommendations**

Akinsanya and Hayward (1980:429) recommended that urgent attention be given to the organisation and input of biological sciences in nursing programmes. Professional nurses should be kept abreast by

- in-service education
- attending symposia and workshops where these sciences are applied
- bridging the gap between theory and practice by encouraging classroom tutors involved in teaching biological sciences to follow or accompany their student nurses in the clinical area. Professional nurses in the clinical area should be given the biological science study guide and curriculum for the four-year course and work together with tutors who teach these sciences.

4.4.5 Item 5

Item 5 investigates whether the professional nurses have access to a library while in the clinical area. Responses to item 5 are reflected in table 4.26.

Table 4.26: Accessibility of professional nurses to a library while in clinical area

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Strongly agree	13	52	80%
2	Agree	7	28	
3	Disagree	1	4	20%
4	Strongly disagree	4	16	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (80%) of the professional nurses *strongly agree* and *agree* that they have no access to a library while in the clinical situation. However, 20% of the professional nurses *disagree* and *strongly disagree* that they have no access to a library while in the clinical area. This is really a constraint on the majority of the professional nurses, who do not have access, because they cannot refer to biological science textbooks if they are faced with a scientific problem.

➤ **Recommendations**

Each hospital sateilite campus should have a mini library where nursing science textbooks to update professional nurses are available. Expensive books should be made available on a rotational basis.

4.4.6 Item 6

Item 6 investigates whether the professional nurses feel student nurses are involved in the formulation of the clinical teaching learning programme in the surgical unit. The responses

to item 6 are reflected in table 4.27.

Table 4.27: Involvement of student nurses in the formulation of clinical teaching-learning programme in the surgical unit

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	10	40	48%
2	Frequently	2	8	
3	Seldom	8	32	52%
4	Never	5	20	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (52%) of the professional nurses indicated that they *seldom* and *never* involve the student nurses in the formulation of the clinical teaching-learning programme in the surgical unit while 48% of the professional nurses indicated that they *frequently* and *always* involve the student nurses in the formulation of the clinical teaching learning programme in the surgical unit.

➤ **Recommendations**

The researcher agrees with Haoses (1990:212) who advocates that the broad framework of a clinical teaching-learning programme should be given to the student nurses. Involving the student nurses would mean that they would take ownership of the study programme.

4.4.7 Item 7

Item 7 investigates whether the specific and general objectives of applied biophysics and biochemistry are explained to the student nurses. The responses to item 7 are reflected in table 4.28.

Table 4.28: Explanation of specific and general objectives of applied biophysics and biochemistry to student nurses

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	1	4	24%
2	Frequently	5	20	
3	Seldom	14	56	76% ??
4	Never	5	20	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (76%) of the professional nurses indicated that they *seldom* and *never* explain the specific and general objectives of applied biophysics and biochemistry to the student nurses while 24% of the professional nurses indicated that they *frequently* and *always* explain the specific and general objectives of applied biophysics and biochemistry to the student nurses.

➤ **Recommendations**

Student nurses should be involved in the formulation of objectives. Quinn (1995:105) maintains that one of the elements of the process design for andragogy is to involve student

nurses in the formulation of objectives. The objectives should be specific, measurable, attainable, realistic and stated clearly before any lecture demonstration. Continuous evaluation of student nurses in the clinical area should be based on the specific objectives of these life sciences.

4.4.8 Item 8

Item 8 evaluates whether the importance of applied biophysics and biochemistry is emphasised in the learning experiences of student nurses. The responses to item 8 are reflected in table 4.29.

Table 4.29: Emphasis on the importance of applied biophysics and biochemistry in the learning experiences of student nurses

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	5	20	44%
2	Frequently	6	24	
3	Seldom	13	52	56%
4	Never	1	4	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (56%) of the professional nurses indicated that they *seldom* and *never* emphasise the importance of applied biophysics and biochemistry in the learning experiences of student nurses in the surgical unit. However, 44% of the professional nurses indicated that they *always* and *frequently* emphasise the importance of applied biophysics and biochemistry in the learning experiences of student nurses in the surgical unit.

➤ **Recommendations**

Clarke (1995:405) maintains that it is in ensuring safe care in adult hospital, community nursing and in child health nursing that biological science knowledge is particularly important. Community nursing and primary health care are becoming increasingly important in this country with professional nurses working on their own, independently of other professionals. Life sciences are crucial to the safety and well-being of patients (Akinsanya 1987:269). Jordan and Reid (1997:169) point out that knowledge of these sciences does not only enhance nurses' understanding of clinical nursing but also directly benefits patients. Biological science should form a basis for nursing competency (Courtenay 1991:1110). Over and above this, however, the nursing profession as a whole must show that it values biological science knowledge.

4.4.9 Item 9

Item 9 investigates if the relationship between biophysics and biochemistry and other nursing subjects is indicated to the student nurses. The responses to item 9 are reflected in table 4.30.

Table 4.30: Indication to the student nurses of the relationship between biophysics and biochemistry and other nursing subjects

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	8	32	> 68%
2	Frequently	9	36	
3	Seldom	6	24	> 32%
4	Never	2	8	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (68%) of the professional nurses indicated that the relationship between biophysics and biochemistry and other nursing subjects is *always* and *frequently* indicated to the student nurses while 32% of the professional nurses indicated that the relationship between biophysics and biochemistry and other nursing subjects is *seldom* and *never* indicated to the student nurses.

➤ **Recommendations**

The researcher agrees with Clarke (1995:405) who advocates a holistic approach, stating that the particular combination of knowledge from the biological, psychological and social sciences, the ability to relate one area of knowledge to another and to apply it to the particular problem presented distinguishes the professional from the non-professional. Holism can only be achieved if all areas of relevant knowledge are acquired and used in a balanced way. It is thus imperative for the relationship between these life sciences and other nursing subjects to be indicated to student nurses. Hinwood (1981:preface) contends that the integration of the strands of science is designed to assist student nurses in understanding the total effect of science on nursing practice. Student nurses should thus be made aware of the total effect of science on nursing.

4.4.10 Item 10

Item 10 investigates whether the procedures/activities in the surgical unit are related to applied biophysics and biochemistry. The responses to item 10 are reflected in table 4.31.

Table 4.31: Relation of procedures/activities in the surgical unit to applied biophysics and biochemistry

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	14	56	> 80%
2	Frequently	6	24	
3	Seldom	3	12	> 20%
4	Never	2	8	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (80%) of the professional nurses indicated that the procedures/activities in the surgical unit are *always* and *frequently* related to applied biophysics and biochemistry while 20% of the professional nurses indicated that procedures/activities are *seldom* or *never* related to applied biophysics and biochemistry.

➤ **Recommendations**

Trnobranski (1993:495) indicates that intelligent practice results from the meaningful application of relevant theory in the context of caring for patients. The United Kingdom Central Council for Nursing, Midwifery and Health Visiting states that the Project 2000 preparation for practice should include life (biological) sciences relevant to nursing practice, normal and disordered structure and function (Trnobranski 1993:494).

A theoretical framework which links nursing directly to the life sciences depends on the clinical application of the life sciences concepts which underpin the theory of nursing (Akinsanya 1987:270). The relationship of these life sciences should be emphasised to

student nurses whenever procedures are done.

4.4.11 Item 11

Item 11 investigates whether the specific objectives of applied biophysics and biochemistry are included in the continuous evaluation of student nurses in the surgical unit. The responses to item 11 are reflected in table 4.32.

Table 4.32: Inclusion of specific objectives of applied biophysics and biochemistry in the continuous evaluation of student nurses in the surgical unit

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	4	16	52%
2	Frequently	9	36	
3	Seldom	7	28	48%
4	Never	5	20	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (52%) of the professional nurses indicated that they *always* and *frequently* include the specific objectives of applied biophysics and biochemistry in the continuous evaluation of student nurses in the surgical unit. However, 48% of the professional nurses indicated that they *seldom* and *never* include specific objectives of biophysics and biochemistry in the continuous evaluation of student nurses in the surgical unit.

➤ **Recommendations**

The evaluation of student nurses before, during and after lecture demonstrations should be based on previously stated learning objectives and biophysics and biochemistry should always be included here.

4.4.12 Item 12

Item 12 investigates whether the principle that fluids at rest transmit pressure equally or evenly in all directions is explained to student nurses when the blood pressure cuff compresses an artery. Responses on item 12 are reflected in table 4.33.

Table 4.33: Explanation to student nurses of the principle that fluids at rest transmit pressure equally or evenly in all directions when the blood pressure cuff compresses an artery

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	4	16	52%
2	Frequent	9	36	
3	Seldom	7	28	48%
4	Never	5	20	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (52%) of the professional nurses indicated that they *always* and *frequently* explain Pascal's law (ie, that fluids at rest transmit pressure equally or evenly in all directions) to student nurses when the blood pressure cuff compresses an artery, and 48% of the professional nurses indicated that they *seldom* or *never* explain Pascal's law to student

nurses when the blood pressure cuff compresses an artery.

➤ **Recommendations**

It is encouraging to note that in this example of the application of an important biophysical principle, the majority of the professional nurses indicated that they could explain the principle. However, there is room for improvement. This is a nursing action that is performed very often and an opportunity to explain the action should therefore come up very often.

The properties of liquid under pressure are important for body function. Pascal's law states that pressure exerted in a confined liquid is transmitted equally in all directions. A change in pressure at any point will result in the pressure change being transmitted equally throughout the liquid (Hinwood 1981:101). It is thus imperative that professional nurses should make student nurses aware that compression of the upper-arm by the cuff of the sphygmomanometer prevents blood flowing through the brachial artery hence the patient experiences numbness if more pressure is exerted. Releasing the cuff pressure will allow the diastolic pressure to move blood through the arm and thus relieve numbness.

4.4.13 Item 13

Item 13 investigates whether the principle that for every action there is an equal but opposite reaction is related to the development of pressure sores when nursing a bedridden, unconscious, emaciated patient. The responses to item 13 are reflected in table 4.34.

Table 4.34: Explanation of the relationship of the principle that for every action there is an equal and opposite reaction to the development of pressure sores when nursing a bedridden, unconscious, emaciated patient

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	9	39	65%
2	Frequently	6	26	
3	Seldom	1	5	35%
4	Never	7	30	
TOTAL (n)		**23**	**100**	

➤ **Findings**

Two professional nurses did not answer this question (see n). The majority (65%) of the professional nurses indicated that Newton's third law of motion (ie, for every action there is an equal and opposite reaction) is *always* and *frequently* related to the development of pressure sores when nursing a bedridden unconscious, emaciated patient. However, 35% of the professional nurses stated that they *seldom* or *never* related this principle to the development of pressure sores.

➤ **Recommendations**

For Newton's law of motion to be meaningful in practice to student nurses it is advocated that this law be taught and applied at a bedside of the patient to give them a clear picture of what is happening in the real-life situation. Thus, in the case of Newton's third law of motion, a patient lying on a bed exerts a force on the bed and the bed, in turn, exerts an equal and opposite force on the patient (Hofmeyer 1991:101). If an unconscious patient's position is not changed at two-hourly intervals, the patient is liable to develop pressure sores because

of the equal and opposite pressure of the mattress on the patient.

4.4.14 Item 14

Item 14 investigates whether the importance of water vapour is indicated to student nurses during administration of oxygen. The responses to item 14 are reflected in table 4.35.

Table 4.35: Indication to the student nurses of the importance of water vapour during administration of oxygen

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	8	32	76%
2 Frequently	11	44	
3 Seldom	5	20	24%
4 Never	1	4	
TOTAL (n)	**25**	**100**	

➤ **Findings**

The majority (76%) of the professional nurses indicated that the importance of water vapour during administration of oxygen is *always* and *frequently* indicated to the student nurses, which is encouraging. However, 24% of the professional nurses stated that the importance of water vapour during administration of oxygen is *seldom* and *never* indicated to the student nurses.

4.4.15 Item 15

Item 15 investigates whether the physical and chemical properties of urine are explained to

the student nurses during urinalysis. The responses to item 15 are reflected in table 4.36.

Table 4.36: Explanation of the physical and chemical properties of urine to student nurses during urinalysis

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	14	56	88%
2	Frequently	8	32	
3	Seldom	3	12	12%
4	Never	0	0	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (88%) of the professional nurses indicated that the physical and chemical properties of urine are *always* and *frequently* explained to student nurses during urinalysis. However, 12% of the professional nurses indicated that the physical and chemical properties of urine are *seldom* explained to the student nurses during urinalysis. This finding shows that it is possible for professional nurses to help student nurses to apply biochemist. ✓ in the clinical situation.

4.4.16 Item 16

Item 16 investigates whether the scientific reasons for high specific gravity are explained to student nurses when nursing an unconscious patient with diminished dark urine. The responses to item 16 are reflected in table 4.37.

Table 4.37: Explanation to student nurses of the scientific reasons for high specific gravity when nursing an unconscious patient with diminished dark urine

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Always	9	36	> 64%
2 Frequently	7	28	
3 Seldom	5	20	> 36%
4 Never	4	16	
TOTAL (n)	**25**	**100**	

➤ **Findings**

The majority (64%) of the professional nurses indicated that they *always* and *frequently* explain the scientific reasons for high specific gravity to student nurses when nursing an unconscious patient with diminished dark urine, while 36% of the professional nurses indicated that they *seldom* or *never* explain the scientific reasons for high specific gravity to student nurses when nursing an unconscious patient with diminished dark urine.

➤ **Recommendation**

Dehydration is a very important clinical manifestation, which can have serious consequences. Therefore all nurses should understand the relationship between dehydration and a high specific gravity.

4.4.17 Item 17

Item 17 investigates whether the scientific reasons for putting the urine bag at low levels when nursing a patient with an urinary catheter *in situ* is indicated to student nurses. The

responses to item 17 are reflected in table 4.38.

Table 4.38: Indication to student nurses of scientific reasons for putting the urine bag at low levels when nursing a patient with urinary catheter *in situ*

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	18	72	88%
2	Frequently	4	16	
3	Seldom	2	8	12%
4	Never	1	4	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (88%) of the professional nurses indicated that they *always* and *frequently* explain the scientific reasons for putting the urine bag at low levels when nursing a patient with urinary catheter *in situ* to student nurses. However, 12% of the professional nurses indicated that they *seldom* and *never* explain the specific reasons for putting the urine bag at low levels when nursing a patient with an urinary catheter *in situ.*

4.4.18 Item 18

Item 18 investigates whether gravitational force is related to raising the intravenous drip set above the patient's level during intravenous therapy. Responses on item 18 is reflected in table 4.39.

Table 4.39: Relation of gravitational force to raising the intravenous drip set above the patient's level during intravenous therapy

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	17	68	88%
2	Frequently	5	20	
3	Seldom	2	8	12%
4	Never	1	4	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (88%) of the professional nurses stated that they *always* and *frequently* related gravitational force to raising the intravenous drip set above the patient's level during intravenous therapy. However, 12% of the professional nurses indicated that they *seldom* and *never* related gravitational force to raising the intravenous drip set above the patient's level during intravenous therapy.

➤ **Recommendation**

Since this procedure is concerned with fluid and electrolyte balance, it is crucial for safe professional practice for all nurses to understand the scientific basis. Thus there is an important theoretical and practical relationship between basic and life sciences and the nursing management of an intravenous infusion (Akinsanya 1987:271).

4.4.19 Item 19

Item 19 investigates whether different solutions are explained to student nurses during wound

irrigation. The responses to item 19 are reflected in table 4.40.

Table 4.40: Explanation to student nurses of the different types of solutions during wound irrigation

RESPONSES		TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1	Always	16	64	84%
2	Frequently	5	20	
3	Seldom	3	12	16%
4	Never	1	4	
TOTAL (n)		**25**	**100**	

➤ **Findings**

The majority (84%) of the professional nurses affirmed that they *always* and *frequently* explain different solutions to student nurses during wound irrigation. However, 16% of the professional nurses indicated that they *seldom* and *never* explain different solutions to student nurses during wound irrigation.

➤ **Recommendation**

Delayed wound healing prolongs hospital stay, so it is important for all student nurses to be made aware of the reasons why the correct solution should be used.

4.4.20 Open-ended questions

4.4.20.1 First open-ended question

Item 20, which is the first open-ended question, investigates how much opportunity the professional nurses have in their present job to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit. The number of responses to item 20 are reflected in table 4.41.

Table 4.41: Number (n) of professional nurses who answered and who did not answer the first open-ended question

PROFESSIONAL NURSES	TOTAL (n)	PERCENT
Answered	24	96
Not answered	1	4
TOTAL (n)	**25**	**100**

The responses to item 20 are reflected in table 4.42.

Table 4.42: Opportunity to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit

RESPONSES	TOTAL (n)	PERCENTAGE	CUMULATIVE TOTAL FOR 1 AND 2; 3 AND 4
1 Much opportunity	6	25	> 38%
2 Moderate opportunity	3	13	
3 Little opportunity	12	50	> 63%
4 No opportunity	3	13	
TOTAL (n)	**24**	**100**	

➤ **Findings**

Twenty-four professional nurses answered this question and one professional nurse did not. The majority (63%) of the professional nurses indicated that they have *little* or *no opportunity* in their present job to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit. However, 38% of the professional nurses stated that they have *much* or *moderate opportunity* in their present job to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit.

The following reasons are often mentioned in nursing practice for *little* or *no opportunity*:

- shortage of staff
- overcrowding of patients in the surgical unit
- abnormal workload
- no study guides or curriculum documents in the ward
- current literature (nursing books) not available in the ward
- no communication between college and practice

The same number of professional nurses answered the second and third open-ended questions. Of the 25 questionnaires received from the professional nurses, 23 professional nurses answered these questions (items 21 and 22 on the questionnaire).

Table 4.43: Professional nurses who answered and who failed to answer the second and third open-ended questions

PROFESSIONAL NURSES	TOTAL (n)	PERCENTAGE
Answered	23	92
Not answered	2	8
TOTAL (n)	**25**	**100**

4.4.20.2 Second open-ended question

Item 21 investigates whether the professional nurses are interested in applying or motivated to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit. The responses to this question are reflected in table 4.44.

Table 4.44: Professional nurses' motivation to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit

RESPONSE	TOTAL (n)	PERCENTAGE
Yes	23	100
No	0	0
TOTAL (n)	**23**	**100**

➤ **Findings**

All the professional nurses are motivated to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical unit. Table 4.45 reflects why the respondents answered *yes* to this question (reasons).

Table 4.45: Reasons why the professional nurses answered *yes* to item 21

REASONS FOR YES	TOTAL (n)	PERCENTAGE
(1) Scientific principles form the basis of nursing procedures	1	5,5
(2) For student nurses to understand the procedure	1	5,5
(3) To correlate theory to practice	2	11,1
(4) To empower student nurses with knowledge	1	5,5
(5) To take part in teaching and training students	3	16,7
(6) To share knowledge with student nurses	1	5,5
(7) To keep abreast/update of professional knowledge	2	11,1
(8) To be able to detect abnormality	1	5,5
(9) To prevent medico-legal hazards	3	16,7
(10) To render/provide scientific care	2	11,1
(11) To produce proficient nurses for the future	1	5,5
TOTAL (n) OF REASONS = 11	**18**	**100,0**

➤ **Findings**

Eleven different responses were listed. Of all the questionnaires, a total of 18 responses were recorded. Of the 23 professional nurses who answered *yes* to this question, 6 failed to give reasons for their motivation. The total number of 17 professional nurses who gave reasons for their motivation does not correspond with the total number of 18 responses because one professional nurse gave two reasons.

➤ **Recommendation**

It is clear that the professional nurses are motivated and ready to take part in any teaching activities where biophysics and biochemistry content is relevant. These nurses should thus be given the opportunity to take part and the necessary support and resources should be provided.

4.4.20.3 Third open-ended question

Item 22 required the respondents to indicate the activities performed by nurses that involve the application of biophysics and biochemistry and could be initiated independently of medical prescription, if they had an appropriate understanding of the underlying sciences. The number of procedures/activities does not correspond to the total number of professional nurses who answered this question because most of the professional nurses gave more than one procedure. However, some failed to indicate the appropriate scientific principle. In several cases the procedures were similar to those cited in the questionnaire before. The responses to item 22 are reflected in table 4.46.

Table 4.46: Activities performed by nurses that involve the application of biophysics and biochemistry principles and can be initiated independently of medical prescription

NURSING ACTIVITIES/ PROCEDURES		BIOPHYSICS AND BIOCHEMISTRY PRINCIPLES	TOTAL (n)	PERCEN-TAGE
(1)	Urine testing	Physical and chemical properties	8	10,95
(2)	Nasogastric feeding	Gravitational force	1	1,36
(3)	Intravenous therapy	Gravity, electrolytes, solution	12	16,43
(4)	Oxygen therapy	Humidity, elements	14	19,17
(5)	Blood pressure taking	Boyle's law	9	12,32
(6)	Bowel washout	Gravitational force	1	1,36
(7)	Temperature, pulse, respiration	Heat, temperature, measurement	7	9,58
(8)	Intake and output	Measurement	1	1,36
(9)	Weighing of patient	Mass, weight, measurement	1	1,36
(10)	Intercostal drainage	Gravitational force	7	9,58
(11)	Elevation of swollen limbs	Gravitational force	1	1,36
(12)	Tepid sponging	Heat and temperature	1	1,36
(13)	Changing patient's position	Newton's third law of motion	5	6,84
(14)	Suctioning of patient	Pressure (negative)	4	5,47
(16)	Postural drainage	Gravitational force	1	1,36
			73	**100,0**

➤ **Findings**

Fifteen different responses were listed. Of all the questionnaires, a total of 73 responses were recorded; 3 responses were the same as previously asked in the questionnaire and 12 responses were original. Table 4.46 indicates the frequency and percentage of the responses. It is encouraging to see so many, but more procedures could have been mentioned.

4.5 SUMMARY

This chapter discussed data analysis and the findings from questionnaire A for student nurses and questionnaire B for professional nurses. Tables were used to reflect the responses as well as percentages. In most cases recommendations were made with reference to the findings.

CHAPTER 5

Overview of findings, recommendations, limitations of the study and concluding remarks

5.1 INTRODUCTION

The objective of the current nursing curriculum is to produce reflective, creative, competent, informed and critical thinking nursing practitioners, who will provide clients with high quality nursing care. As an important member of the health team, a nurse's unique contribution is related to the type of education and training she receives as a student nurse and how she updates her knowledge and skill through practice (Akinsanya 1987:274). Knowledge could not only enhance the understanding of clinical nursing but also be directly applied to the benefit of patient (Jordan & Reid 1997:169).

Professional nurses should act as resource people to empower student nurses with scientific knowledge. Biophysics and biochemistry principles form part of the scientific foundation on which nurses base their actions and rationale when meeting clients' needs and solving

their problems. In this study, however, it was clear that this is not always the case. All in all it was found that it is at the level of integration of theory and practice that the greatest problems are experienced.

Tyler (1949:55) cited that without theory, practice becomes chaotic, merely a collection of isolated, individual cases. Theory gives meaning and unity to what would otherwise be specific and isolated cases. On the other hand, without practice theory becomes mere speculation. The realities of practice provide a check upon pure speculation, a test of the adequacy of theory and also practice provides the problems which must be dealt with by any comprehensive theory. Hence these efforts to connect theory and practice more closely are important contributions to professional education. In addition Infante, Forbes, Houldin, Naylon and Faan (1989:132) recommended a greater synchronisation of clinical experiences with instruction in nursing theory and science to meet the complex health care needs of our time.

5.2 FINDINGS ON STUDENT NURSES

Student nurses felt that they were not involved in the formulation of the clinical teaching learning programme. In the practical situation, the specific and general objectives of applied biophysics and biochemistry were not explained to them and not even included in their continuous evaluation.

They indicated further that they were not explicitly made aware of applied biophysics and biochemistry in the clinical situation. Application could have been indicated more often in their nursing activities/procedures so that students can see the relevance of biological science as a basis of nursing care.

In the case of specific examples of biophysics and biochemistry content integration, it was found that in some cases the rationale for action was clear, but not in others. Provision should thus be made for improvement by encouraging professional nurses to provide learning material which include examples of the application and use of the biological science for

practice (Clarke 1995:406).

The open-ended question revealed that student nurses were highly motivated to apply biophysics and biochemistry principles and know the scientific rationale for a variety of nursing procedures. From some of the other questionnaires it was clear that there is still a lot of room for more learning, teaching and application of these scientific principles/concepts in the clinical situation because most of the respondents could not mention examples other than those used in the questionnaire.

5.3 FINDINGS ON PROFESSIONAL NURSES

Although some of the professional nurses felt that they have the scientific background, it was found that even the respondents who had a knowledge of these life sciences, lacked the ability to apply them and still had to rely on medical and tutorial staff to simplify scientific concepts. The reason for this could be, as came out in the study, that library accessibility in the clinical areas is a big problem.

As in the case of the student nurses, it was revealed that explaining objectives was a problem. Professional nurses were not sure of the objectives and therefore not able to indicate the importance of applied biophysics and biochemistry to the nurses in their learning experiences. In spite of this, it was found that they (professional nurses) felt they indicated the importance of these subjects to the student nurses.

Like the student nurses, the professional nurses could mention biophysics and biochemistry principles related to specific nursing actions/procedures in some cases and not in others. The professional nurses felt that they did not have enough opportunity to apply these scientific principles for various reasons. Clarke (1995:406), however, states that even if professional nurses act as mentors in the clinical areas, there is much evidence to suggest that they do not have the knowledge in an explicit enough form to teach in an applied way, even if there was enough time in which to do so.

The majority of the professional nurses were motivated to apply these scientific principles for various reasons. Like the student nurses, the professional nurses were not innovative in giving their own examples of nursing activities that involve the application of biophysics and biochemistry because many of their applications were the same as those in the questionnaire.

5.4 RECOMMENDATIONS ON NURSING PRACTICE AND NURSING EDUCATION

In this section recommendations relevant to nursing practice and nursing education are listed. Some recommendations have relevance for nursing practice and nursing education at the same time.

5.4.1 Nursing practice

- Clinical teaching learning programmes should be arranged so that there is more effective integration of the practice of nursing and the scientific theory on which it depends.
- For each ward where scientific principles are involved in nursing activities, the specific scientific principles should be continually listed and updated. Innovation in this regard is important so that not only the best known principles but all are listed.
- Nursing skills should be categorised in relation to the specific scientific underpinning.
- Objectives seem to be a problem in the clinical area and should be discussed at various levels.
- Professional nurses should be made aware of how to use these objectives when indicating what is expected of student nurses.
- Student nurses should be involved in the formulation of the objectives and ensure that biophysics and biochemistry feature in the clinical teaching learning programme.
- Biophysics and biochemistry objectives should feature in the clinical evaluation process.
- Clinical tutors should address not only the learning needs of student nurses but also of professional nurses, who are an extension of tutors in the practical situation.

- Biophysics and biochemistry should be included in the in-service training sessions for professional nurses.
- Library accessibility should be addressed. Professional nurses in teaching hospitals form part of a comprehensive teaching-learning team, and should therefore have access to libraries.
- The two groups included in the study are highly motivated to know more about the application of biophysics and biochemistry principles in the clinical situation. Opportunities thus need to be created for this.

5.4.2 Nursing education

- Tutors who successfully teach biological sciences to nurses should share their expertise widely with other teachers, professional nurses included (Clarke 1995:406).
- Creativity and innovation are necessary. Tutors and professional nurses should be made aware that this is a field where creative and innovative teaching is important and should act accordingly.
- An appropriate nursing curriculum that enables student nurses, professional nurses, classroom and clinical tutors to link theory with practice in biophysics and biochemistry should be considered because current nursing syllabi do not appear to encourage an innovatory approach to these sciences (Akinsanya 1987:274).
- An organised and integrated curriculum that will bring all nursing subjects together to form a unified and meaningful whole is advocated (Greaves 1987:26).
- Student nurses' biological knowledge base for practice should be clearly defined and structured and also organised progressively throughout their training (Akinsanya & Hayward 1980:428).
- To avoid reliance of professional nurses on medical staff for clarification of scientific concepts, a bionursing model is advocated because it may encourage the nurse to look directly at the roots rather than the branches of the life sciences and their application to nursing care could link to a better understanding of the reasons for their application, greater professional competence and enhanced patient care (Akinsanya 1987:274).

- Continuous research on how to update student nurses and professional nurses should be done to identify more problems in this field.

5.5 RECOMMENDATIONS ON LIMITATIONS OF THE STUDY AND FUTURE RESEARCH

It is strongly recommended that more research be done to overcome the following limitations.

5.5.1 Population

As the population of this study was small, the following categories should also form part of a population in further research:

- More nursing college in Gauteng Province should be included.
- First-, third- and fourth-year student nurses should also form part of the population.
- All disciplines in the clinical area should be involved, not only surgical areas as in this study.
- Classroom tutors, professional nurses from other disciplines and clinical instructors should also be included in a study.
- Different findings could possibly result from larger studies including other colleges of nursing, different categories of nurses and various disciplines.

5.5.2 Questionnaires

More open-ended questions should be added to get the true perception of student nurses and professional nurses on the application of biophysics and biochemistry in the learning experiences of student nurses. The questions in the two questionnaires should correlate. It is important to compare the views of student nurses and professional nurses. Questionnaires directed to clinical and classroom tutors could be added to investigate the teaching methods/strategies of biological sciences. The correlation between college and service in the

teaching of biophysics and biochemistry was also not investigated, and should receive attention in future studies.

5.5.3 Further research

This study found several areas that need further investigation, including the following:

- The nature of biological science knowledge required for professional nursing practice.
- The role of biological sciences in nursing education/practice.
- The content taught by classroom tutors and the teaching methods used.
- Innovative ways of teaching biological sciences and promoting their application to nursing practice.
- The depth to which these life sciences should be taught, learnt and applied in nursing practice.
- Identification of the precise amount of biological science knowledge or content on which safe nursing practice rests.

5.6 REVIEW OF THE AIM AND OBJECTIVES OF THE STUDY

Objectives stated for this study are as follows:

- review related literature which indicates
    - the importance of theory/practice integration in nursing and research findings on this issue
    - the importance of biophysics and biochemistry in the nursing curriculum and research finding on this issue
- determine student nurses' knowledge of biophysics and biochemistry related to certain nursing activities/procedures in surgical units
- determine whether professional nurses are capable of teaching student nurses the

application of biophysics and biochemistry related to certain nursing procedures/activities in surgical units

- make recommendations for nursing practice and nursing education based on this study

Literature was extensively reviewed in chapter 2. Recent research as well as textbooks on biological science were consulted.

In order to determine student nurses' knowledge of biophysics and biochemistry related to nursing activities/procedures in surgical units, a questionnaire A (annexure B) was distributed. Findings from this questionnaire were reported and discussed.

In order to determine whether professional nurses are capable of teaching student nurses the application of biophysics and biochemistry related to nursing activities/procedures in surgical units, a questionnaire B (annexure C) was administered. Findings from this questionnaire were reported and discussed.

Recommendations based on the findings reported were made for nursing practice as well as nursing education. Recommendations were also made for further research.

5.7 CONCLUSION

According to Akinsanya (1987:274), what is also required is a bold step which approaches the teaching of life sciences within a framework in which categories and principles derived from the life sciences are seen first and foremost as a legitimate vocabulary of nursing instead of ideas borrowed from medicine. Nurses should not only base their practice on sound biological knowledge but be seen an heard to do so (Clarke 1995:405). This can only enhance their credibility with both clients and employers.

Improved patient care therefore depends on teaching these life sciences and simultaneously applying them to nursing care, which is the essence of the bionursing model (Akinsanya 1987:274). A new effective method of teaching biophysics and biochemistry should be

sought if student nurses are to be encouraged to apply them in their learning experiences in the ward (Courtenay 1991:1113). There is therefore a need to identify the specific aspects of these life sciences that apply to nursing practice and the depth to which they should be studied (Trnobranski 1993:496). Medical technology always involves biophysical and/or biochemistry principles. Nurses increasingly depend upon knowledge from the natural sciences and on the machines developed from modern technology (Holmes 1972:655).

As technology advances, professional nurses should be kept updated to ensure patient safety. These updates should be underpinned by the life sciences in order to develop schemata for organising clinical experiences into meaningful learning (Jordan & Reid 1997:176). According to Ausubel (1968:24), meaningful learning takes place if learning tasks can be related in nonarbitrary substantive fashion to what learners already know and if learners adopt a corresponding learning set. Both within and outside the classroom, meaningful learning is the principal means of acquiring and applying knowledge for future.

Despite the general acknowledgement that biological science is directly relevant to the preparation of nurses for practice, researchers such as Akinsanya (1987:269), Chapple, Allcock and Wharrad (1993:427) and Trnobranski (1993:494) concede that there is dearth or paucity of research into the role of the biological sciences in nursing education and practice. Trnobranski (1993:494) cited Akinsanya that in contrast, an abundance of research literature is evident for the social sciences related to nursing. The researcher is thus urging nurses to take responsibility in conducting research in the area where these life sciences are taught, learnt and applied in nursing. Moreover, the nursing profession as a whole must show that it values biological science knowledge in its application to nursing practice (Clarke 1995:406).

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Annexure A

Letters of approval

TAK ALGEMENE PROVINSIALE DIENSTE
GENERAL PROVINCIAL SERVICES BRANCH

TRANSVAAL PROVINCIAL ADMINISTRATION
TRANSVAALSE PROVINSIALE ADMINISTRASIE

ANNEXURE A

NAVRAE / ENQUIRIES: Mr. J.W. Horn

VERW / REFERENCE:

TELEPHONE NUMBER:
TELEFOONNOMMER: 201-3134

Miss J.S. Ntlokotsi
P/A Bonalesedi Nursing College.
P/Bag X 1001
Lilliesleaf 1763

Dear Miss Ntlokotsi.

RESEARCH: Applied Biophysics and Biochemistry in the learning experience of student nurses in the surgical unit

I have pleasure informing you that approval has been granted to do research at the following Hospitals:
Rakeblee - Benoni -, Natalspruit -, Leratong and Sebokeng Hospitals

The approval is subjected to the following conditions:

i) The Superintendents of the different Hospitals must be contacted by yourself to obtain permission to do research.

ii) The research may not intervene with the service of the officers concerned.

iii) The Superintendents of the different Hospitals must always be informed concerning the project.

iv) A copy of the completed treatise must be presented to this Administration.

v) Please bare in mind the position of trust as well as the confidentiality of the treatise.

We wish you success with your project.

Yours faithfully

DIRECTOR GENERAL

93/8/30

PRIVAATSAK/PRIVATE BAG X0001 PRETORIA 0001
FAKS: 3257720
FAX: 3257720

ANNEXURE A

81/506565
TPH 49

TRANSVAALSE PROVINSIALE HOSPITALE

Telegrafiese adres "Hospital"
Telegraphic address

Telefoon No. 892-1144/61
Telephone No. Mrs. Small F.C.

IN ANTWOORD VERMELD ASB.
IN REPLY PLEASE QUOTE

No.....

Alle korrespondensie moet aan die Superintendent gerig word.

All communications to be addressed to the Superintendent.

TRANSVAAL PROVINCIAL HOSPITALS

Boksburg-Benoni Hospitaal
Hospital

Private Bag X2

BOKSBURG

1460

PROVINSIALE ADMINISTRASIE TRANSVAAL
BOKSBURG-BENONI HOSPITAAL
PRIVAATSAK BOKSBURG
MATRONE SE AFDELING
1993-10-14
MATRON'S DEPARTMENT
PRIVATE BAG BOKSBURG
BOKSBURG-BENONI HOSPITAL
PROVINCIAL ADMINISTRATION TRANSVAAL

ATTENTION: MISS NTLOKOTSI J.S.

The Principal
Bonalesedi Nursing College
Private Bag X1001
LUIPAARDSVLEI
1743

RE: RESEARCH PROJECT - QUESTIONNAIRE

We hereby informing you that permission is granted to you for your research project at the Boksburg-Benoni Hospital.

Please let this hospital know:

- How many students and sisters questionnaires will be handed out.
- Date of commencing the project.

We wish you success and our co-operation with this project.

SENIOR NURSING SERVICE MANAGER
for SUPERINTENDENT
1993-10-14

ANNEXURE A

T.P.H. 49

TRANSVAALSE PROVINSIALE HOSPITALE

Telegrafiese Adres
Telegraphic Address .....

Telefoon Nr.
Telephone No. 410-6400 X 203

MATRON

IN ANTWOORD VERMELD ASB.
IN REPLY PLEASE QUOTE

No. .....

Alle korrespondensie moet aan die Superintendent gerig word.

All communications to be addressed to the Superintendent.

TRANSVAAL PROVINCIAL HOSPITALS

LERATONG HOSPITAAL
HOSPITAL

PRIVATE BAG 2006

KRUGERSDORP

1740

LERATONG HOSPITAL
P.
14-10-1993
HOSPITAL

MISS S NTLOKOTSI

BONALESEDI NURSING COLLEGE
PRIVATE BAG X1001
LUIPAARDSVLEI
1743

QUESTIONNAIRE --- RESEARCH: APPLIED BIOPHYSICS AND BIOCHEMISTRY IN THE LEARNING EXPERIENCE OF STUDENT NURSES IN THE SURGICAL UNIT

Your request letter dated 07-10-1993 for permission to submit the above, has reference.

Permission has been granted by Dr P van Heerden, Chief Superintendent of Leratong Hospital to do the research.

Kindly inform us of the total personnel you wish to involve in the project, as well as the collecting date for the questionnaire.

p.p. [signature]

CHIEF NURSING SERVICE MANAGER
DS/adp
1993-10-14

ANNEXURE A
81/506565
TPH 49

TRANSVAALSE PROVINSIALE HOSPITALE

Telegrafiese adres
Telegraphic address.....
Telefoon No. 88-1100 x 302
Telephone No..Mrs..Mtambu..E.....

IN ANTWOORD VERMELD ASB.
IN REPLY PLEASE QUOTE

No.....

Alle korrespondensie moet aan die Superintendent gerig word.

All communications to be addressed to the Superintendent.

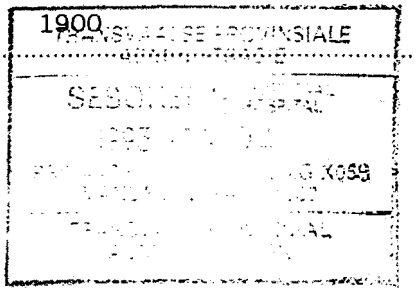
TRANSVAAL PROVINCIAL HOSPITALS

S E B O K E N G Hospitaal
.....Hospital

Private Bag X058
.....

VANDERBIJLPARK
.....

1900
.....



Joyce Shirley Ntlokotsi
Bonalesedi Hospital
Nursing College
Private Bag X1001
LUIPAARDSVLEI
1743

Dear Madam

Permission is hereby granted to submit questionnaire to the sisters and student nurses in the surgical unit.

Thank you

SENIOR NURSING SERVICE MANAGER

/er

ANNEXURE A

GAUTENG PROVINCIAL GOVERNMENT

DEPARTMENT OF HEALTH

Bonalesedi Nursing College
Private Bag X 7
Roodepoort 1725

231

Tel.: (011) 410-1402 Ext.....
Fax: (011) 410-9013

Enquiries: **Mrs. N.T.F. Molefe**

Attention: **Ms. S. Ntlokotsi**

GAUTENG PROV. ADMINISTRATION
BONALESEDI NURSING COLLEGE
PRIVATE BAG X 7 ROODEPOORT 1725
BONALESEDI KOLLEGE VAN VERPLEGING
PRIVAATSAK X 7 ROODEPOORT 1725
PROV. ADMINISTRASIE GAUTENG

Bonalesedi Nursing College
Private Bag X7
ROODEPOORT
1725

RE : PERMISSION TO CONDUCT RESEARCH

Permission is hereby granted for Ms. S. Ntlokotsi to conduct research with Bonalesedi Nursing College Stage II students at Hospital Satellite Campuses for her Masters Degree.

Thank you.

PRINCIPAL

NTFM/mms

ANNEXURE A

Bonalesedi Nursing College
Private Bag X1001
LUIPAARDSVLEI
1743

Enquiries: Miss JS Ntlokotsi

The Principal
Attention: Mrs LT Phore
Bonalesedi Nursing College
Private Bag X1001
LUIPAARDSVLEI
1743

Dear Mrs Phore

RESEARCH TITLE: ***APPLIED BIOPHYSICS AND BIOCHEMISTRY IN THE LEARNING EXPERIENCES OF STUDENT NURSES IN THE SURGICAL UNIT***

I am conducting a study under the supervision of Professor HIL Brink and Dr A Botha to investigate the application of **biophysics** and **biochemistry** in the learning experiences of student nurses in the surgical unit.

The purpose of the study is to investigate if these sciences are integrated in the learning experiences of student nurses.

I therefore request permission to undertake this study at the four hospital satellite campuses. The research will not disturb the hospital routine and data gathered will be treated as confidential. A copy of the completed research report will be submitted to the administration, if required.

At present I am in the staff establishment of Bonalesedi Nursing College and studying for a Master's Degree at the University of South Africa.

Yours faithfully

Ntlokotsi

JOYCE SHIRLEY NTLOKOTSI (MA CUR STUDENT)
1993.07.01

Annexure B

Questionnaire A directed to stage II student nurses

ANNEXURE B

Bonalesedi Nursing College
Private Bag X1001
LUIPAARDSVLEI
1743

Dear Sir/Madam

I am conducting a study under the supervision of Professor HIL Brink and Dr A Botha to investigate the application of **biophysics** and **biochemistry** in the learning experiences of student nurses in the surgical unit.

Your opinion and experiences are very important to the researcher. The information will be kept confidential and completely anonymous, so you are not asked to attach your name on it, or identify yourself in any way. I therefore hope that you will feel comfortable about giving your honest opinion.

Please answer all questions as outlined in the instructions. A collecting box in which you can deposit your completed questionnaire will be placed at the nurses station (surgical unit).

Your participation in this important survey is earnestly requested and your response will be highly appreciated.

Thank you very much for your cooperation and assistance in this endeavour.

Yours faithfully

Ntlokotsi

JOYCE SHIRLEY NTLOKOTSI (MA CUR STUDENT)

ANNEXURE B

Questionnaire A: Stage II student nurses in the surgical unit

Indicate your opinion by marking X in the appropriate column

		Always	Frequently	Seldom	Never
1	Are the student nurses involved in the formulation of the clinical teaching programme in the unit?				
2	Are the specific and general objectives of applied biophysics and biochemistry explained to the students?				
3	Is the importance of applied biophysics and biochemistry in the learning experiences of student nurses emphasised?				
4	Is the relationship between biophysics and biochemistry and other nursing subjects indicated to the students?				
5	Are the procedures/activities in the surgical unit related to applied biophysics and biochemistry?				
6	Are the specific objectives of applied biophysics and biochemistry used in the continuous evaluation of student nurses in the surgical unit?				
7	Is the principle that fluids at rest transmit pressure equally and evenly in all directions explained to students when the blood pressure cuff compresses an artery?				
8	Is the principle that to every action there is equal and opposite reaction related to the development of pressure sores when nursing a bedridden unconscious emaciated patient?				
9	Is the importance of water vapour during administration of oxygen indicated to students?				
10	Are the physical and chemical properties of urine explained to the students during urinalysis?				

		Always	Frequently	Seldom	Never
11	Are the specific reasons for high specific gravity explained to the students when nursing an unconscious patient with diminished dark urine?				
12	Are the scientific reasons indicated for putting the urine bag at low levels when nursing a patient with urinary catheter *in situ*?				
13	Is gravitational force related to raising the intravenous drip set above the patient's level during intravenous therapy?				
14	Are different types of solutions explained to students during wound irrigation?				

Please write an honest answer to the following questions:

1 Which of the nursing activities performed by nurses that involve the application of biophysics and biochemistry principles could you initiate independently of medical prescription if you had an appropriate knowledge of underlying scientific principles.

. . . . . .

. . . . . .

2 Are you interested or motivated to apply these biophysics and biochemistry principles when performing nursing procedures in the surgical unit? Give reasons for your answer.

. . . . . .

. . . . . .

Annexure C

Questionnaire B directed to professional nurses

ANNEXURE C

Bonalesedi Nursing College
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1743

Dear Sir/Madam

I am conducting a study under the supervision of Professor HIL Brink and Dr A Botha to investigate the application of **biophysics** and **biochemistry** in the learning experiences of student nurses in the surgical unit.

Your opinion and experiences are very important to the researcher. The information will be kept confidential and completely anonymous, so you are not asked to attach your name on it, or identify yourself in any way. I therefore hope that you will feel comfortable about giving your honest opinion.

Please answer all questions as outlined in the instructions. A collecting box in which you can deposit your completed questionnaire will be placed at the nurses station (surgical unit).

Your participation in this important survey is earnestly requested and your response will be highly appreciated.

Thank you very much for your cooperation and assistance in this endeavour.

Yours faithfully

Ntlokotsi

JOYCE SHIRLEY NTLOKOTSI (MA CUR STUDENT)

Questionnaire B: Professional nurses in the surgical unit

Please indicate by marking X in the appropriate column whether you do experience the problems stated below in the application of biophysics and biochemistry in the learning experiences of student nurses in the surgical unit.

		Strongly agree	Agree	Disagree	Strongly disagree
1	I lack adequate knowledge of the life sciences biophysics and biochemistry.				
2	I experience problems in attempting to simplify scientific concepts.				
3	I have to rely on the medical staff and tutors to explain scientific aspects of nursing care.				
4	I have difficulty in identifying procedures or activities in the surgical units in which these scientific concepts can be applied.				
5	I have no access to the library while in the clinical situation.				

Indicate your opinion by marking X in the appropriate column.

		Always	Frequently	Seldom	Never
6	Are the student nurses involved in the formulation of the clinical teaching programme in the unit?				
7	Are the specific and general objectives of applied biophysics and biochemistry explained to the students?				

		Always	Frequently	Seldom	Never
8	Is the importance of applied biophysics and biochemistry in the learning experiences of student nurses emphasised?				
9	Is the relationship between biophysics and biochemistry and other nursing subjects indicated to the students in the surgical units?				
10	Are the procedures/activities in the surgical unit related to applied biophysics and biochemistry?				
11	Ae the specific objectives of applied biophysics and biochemistry included in the continuous evaluation of student nurses in the surgical unit?				
12	Is the principle that fluids at rest transmit pressure equally or evenly in all directions explained to students when the blood pressure cuff compresses an artery?				
13	Is the principle that for every action there is an equal but opposite reaction related to the development of pressure sores when nursing a bedridden unconscious emaciated patient?				
14	Is the importance of water vapour during administration of oxygen indicated to students?				
15	Are the physical and chemical properties of urine explained to students during urinalysis?				
16	Are the scientific reasons for high specific gravity explained to the students when nursing an unconscious patient with diminished dark urine?				
17	Are the specific reasons indicated to student nurses for putting the urine bag at low levels when nursing a patient with a urinary catheter *in situ*?				
18	Is the gravitational force related to raising the intravenous drip set above the patient's level during intravenous therapy?				
19	Are different types of solutions explained to the students during wound irrigation?				

Please write an honest answer to the following questions:

20 How much opportunity do you have on your present job to apply biophysics and biochemistry principles in the learning experiences of student nurses in the surgical ward?

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21 Are you interested or motivated to do so? Give reasons for your answer.

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22 Which of the activities performed by nurses that involve the application of biophysics and biochemistry could they initiate independently of medical prescription if they had an appropriate understanding of the underlying sciences? List the activity and the appropriate scientific principle.

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