

Predictors of Success on the Canadian Nurses Association Testing Service (CNATS) Examination

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La présente étude rétrospective a observé la relation entre les variables d'admission sélectionnée et les performances pendant les études par rapport à la réussite aux examens du *Canadian Nurses Association Testing Service (CNATS)* de 114 étudiants admis de l'école secondaire directement à un baccalauréat en sciences infirmières au Canada, programme intégré en quatre ans axé sur l'apprentissage par problèmes. On a analysé les données en utilisant des régressions hiérarchiques. On a examiné dans la première phase de régression une série de notes du secondaire (*Ontario Academic Credits ou OAC*) utilisées pour le calcul des moyennes d'admission à l'université et leur capacité à prévoir la performance quant au CNATS. On a constaté que les meilleures variables prédictives étaient les OAC en anglais, puis les OAC en chimie et la moyenne des admissions obtenue par les OAC dans d'autres matières. On a examiné dans la deuxième phase de régression, les notes obtenues au cours des études comme variables prédictives éventuelles des résultats au CNATS. La meilleure variable prédictive s'est révélée être celle des sciences fondamentales, suivie de celle de la méthodologie de la recherche, les concepts en sciences infirmières (1^{er} niveau), une moyenne en apprentissage par problèmes des sciences infirmières et une moyenne en pratique clinique. Les résultats appuient l'utilisation continue de l'anglais et de la chimie comme critères d'admission. Les cours de sciences fondamentales et ceux de première année en sciences infirmières sont également apparus comme des variables prédictives importantes sur le plan statistique de la réussite à l'examen pour l'obtention du permis d'exercice.

This retrospective study examined the relationship of selected admissions variables and in-course performance to success in the Canadian Nurses Association Testing Service (CNATS) examinations of 114 students admitted directly from secondary school to a four-year integrated, problem-based learning (PBL) baccalaureate nursing program in Canada. Data were analyzed using two separate hierarchical stepwise regression equations. The first equation examined a set of secondary school grades (Ontario Academic Credits, or OACs) used to calculate university admission averages and their ability to predict CNATS performance. OAC English was found to be the best predictor, followed by OAC chemistry and the admission average obtained on other OAC subjects. The second regression equation looked at in-course grades as potential predictors of CNATS scores. The basic sciences variable proved to be the best predictor, followed by research methodology, first-year Nursing Concepts I, a problem-based nursing average, and a clinical practice average. Findings support the continued use of English and chemistry as admission criteria. The basic sciences courses and first-year nursing courses also emerged as statistically significant predictors of licensure examination success.

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The literature is replete with reports of studies into the variables that predict success in professional nursing licensure examinations. Some studies have explored admissions criteria and their relationship to R.N. examination results (Jacono, Keehn, & Corrigan, 1987); others have focused on variables within the nursing program itself for indicators that would predict success on the R.N. examinations (Heupel, 1994; Waterhouse, Carroll, & Beeman, 1993); yet others have studied variables across the spectrum, from admission to courses within the nursing program and their relationship to R.N. outcomes (Froman & Owen, 1989; Wall, Miller, & Widerquist, 1993). In all these studies, multiple variables appear to be the predictors of success.

The present retrospective study was conducted as a component of ongoing research to determine the validity of the selection criteria and the in-course performance of post-high school Ontario Academic Credit (OAC) entrants to the McMaster University B.Sc.N. program as predictors of success on the Canadian Nurses Association Testing Service (CNATS) examinations.

B.Sc.N. Curriculum

The four-year curriculum of the B.Sc.N. program comprises nursing theory and clinical courses, health sciences courses in the basic sciences, research methodology, critical appraisal of literature, and determinants of health, as well as electives. While clinical course work in this program is not unlike that of other nursing programs, theory content is presented in problem-based learning (PBL) format, in small-group tutorials, rather than in content-specific courses. In the PBL format, groups of six to 10 students work with a faculty tutor to explore a variety of health-care scenarios, with the aim of identifying learning and health-care issues in a holistic, client-centred fashion.

Study Design

A two-phase correlational study design was used to test the relationships between:

1. The criterion variable of student performance on the CNATS examination and the predictor variables of admissions criteria (OAC English, OAC chemistry, and overall nursing admission average).
2. The criterion variable of student performance on the CNATS and in-course performance in the B.Sc.N. program as measured by: nursing average, basic science average, health sciences average, PBL average, and clinical practice average.

Outcome Variable

The CNATS examination is the national professional nursing licensure examination, written by graduates of both diploma and baccalaureate programs. The passing score is 350 (out of a possible 700), and the national failure rate is standardized and set at 4% annually.

Predictor Variables

I. Admission criteria. Admission to the four-year B.Sc.N. program for secondary school applicants is based on a nursing admissions average calculated on grades obtained in six subject areas: OAC English, OAC chemistry, one OAC mathematics (i.e., calculus, geometry, or finite math), one additional OAC science (i.e., physics or biology), and two additional OACs (best two subjects in addition to those listed above). For the purpose of this study, a new nursing admission average (NEWADMAV) was recalculated for all students, based on the final grades obtained in four required OAC subject areas excluding English and chemistry. This permitted analysis of OAC English, OAC chemistry, and NEWADMAV as three independent variables, which were then examined to determine their contribution to the variance in CNATS scores.

II. In-course performance (Curriculum Variables). For purposes of analysis, the curriculum was conceptualized as having four "content areas," and averages were calculated using final grades in basic sciences (BASICSCI), health sciences (HLTHSCIAV), PBL, and clinical nursing practice (CLINICAL), excluding the level-four courses. In 1992-93 a pass/fail system was adopted for all clinical courses, thus eliminating a range of individual grades. An exit variable called "nursing average" (REVNSGAV) was calculated based on final grades in all the nursing courses for the four years of the program.

Subjects

Between 1987 and 1989, 149 OAC applicants entered the first year of the B.Sc.N. program. Of these, 114 successfully completed the program four years later, wrote the CNATS examinations within the time frame of the study (i.e., September 1987 to June 1993), and gave permission for the program to access their CNATS scores. Most subjects were females (only two OAC entrants were males during the study years) and between the ages of 17 and 20 at the time of admission to the program.

Data Analysis

Admission variables, in-course marks, and CNATS scores of the 114 subjects were analyzed using both descriptive and inferential statistics.

Findings

CNATS scores ranged from 131 to 690. Nine students (7.8%) received a failing grade (i.e., <350): two in 1991 (5.6%), two in 1992 (5.3%), and five in 1993 (12.5%). While the admissions grades and averages of unsuccessful students were not different from the overall sample, examination of in-course grades did identify the fact that the majority of this group achieved grades below the mean in all courses other than the fourth-year PBL tutorial and the final clinical course of the third year.

The university admission average cut-off ranged from 82.5% in 1987 to 80.0% in 1989. The NEWADMAV calculated for this study, based on math and science grades, resulted in a lower minimum, of 74.5%, for the overall sample; the range for students who subsequently failed the CNATS was 78.3% to 89.0%.

Multiple regression analysis with CNATS as the dependent variable and the academic admission criteria as the independent variables indicated that OAC English was the best predictor of performance on the CNATS, contributing 3.7% of the variance, followed by OAC chemistry, providing an additional 6.6%, and then the nursing admission average, providing an additional 4.2%, for a total of 14.5%.

To examine in-course performance, a forward stepwise regression procedure was used. The BASICSCI was found to be the strongest predictor of success on CNATS, $F(1,112) = 21.15$, $p = .000$, followed by the HLTHSCIAV, PBL, and then CLINICAL averages. While the first-year nursing course (Nursing Concepts I) includes both clinical and PBL components, a stronger association was found by including it in the PBL component and excluding it from the clinical component.

Table 1 *Step-by-Step Hierarchical Regression Comparing Admission Criteria and CNATS Scores (N=114)*

Step	Variable	Partial F	Significance	Variance (R ²)
1.	OAC English	$dF(1,109)$ 4.27	$p = .04$	3.7%
2.	OAC chemistry	$dF(2,108)$ 7.93	$p = .005$	10.3%
3.	NEWADMAV	$dF(3,107)$ 5.30	$p = .02$	14.5%

After determining the best subset of positive predictor variables (again, using a forward stepwise regression analysis), the decision was made to return to an individual-course approach. With fewer variables left to consider, the subject-to-variable ratio was increased. A model was sought that would contribute an R^2 value of at least 30% at the final step, which would indicate significant prediction (Norman & Streiner, 1994). Three courses that were found to have a slightly negative predictive value and two courses that neither added to nor detracted from the regression were dropped from the analysis. Despite these changes to the original design, the four curriculum variables of basic sciences, health sciences, PBL, and clinical components all continued to be represented in the equation. The best set of indicators, based on a hierarchical stepwise regression model, is illustrated in Table 2.

Table 2 *Results of Stepwise Multiple Regression Tests for Predicting CNATS (N=114)*

Step	Variable (Individual Courses)	F	Significance	(R^2)
1.	Human Biological Science I Human Biological Science II	$dF(2,111) = 11.91$	$p = .0000$	17.6%
2.	Introduction to the Research Process	$dF(3,110) = 3.05$	$p = .08$	19.9%
3.	Nursing Concepts Year 1 (PBL)	$dF(4,109) = 6.04$	$p = .01$	24.1%
4.	Nursing Concepts Year 2 (PBL) Nursing Concepts Year 3 (PBL) Nursing Concepts Year 4 (PBL)	$dF(7,106) = 1.84$	$p = .14$	27.8%
5.	Guided Nursing Practice I (Clinical) Guided Nursing Practice II (Clinical) Guided Nursing Practice III (Clinical)	$dF(10,103) = 1.14$	$p = .33$	30.2%

Limitations

One of the concerns regarding PBL is that the interrater reliability of grades among tutors may be low. In an effort to address this concern, detailed course objectives and teaching guides are prepared and tutor meetings are held frequently.

Lack of comparability of grades across secondary schools is acknowledged as a shortcoming. The School of Nursing at present does not weight OAC grades based on reputation of schools, so some inaccuracies may be inherent in comparing the university admission averages of students from many different high schools.

Lack of independence among predictor variables is an ongoing problem in predictive validity research. When those variables serve as selection criteria for admission, the problem is further complicated (Higgs, 1984).

Conclusions

The present study was faced with the challenge of identifying predictive relationships in an integrated, problem-based, small-group, self-directed curriculum in which the content of any given course was not clearly discrete from that of other courses. Students entering any program will bring with them many personal attributes, in addition to their academic qualifications, which will affect their learning within and beyond the formal curriculum. The wide range of electives that students choose also will affect their learning.

The findings of this study cannot be generalized to programs that include other admission variables and/or that have different curricula. Previously published studies report that graduates of PBL curricula may not perform as well as graduates of more traditional programs (Albanese & Mitchell, 1993; Vernon & Blake, 1993). However, measures such as licensure examinations show that nearly all the graduates of the B.Sc.N. program at McMaster are successful in writing the CNATS on the first attempt.

Integrated curricula may be more suited to academically strong students (Whitley & Chadwick, 1986), and McMaster has been able to fill program places with highly qualified applicants (high school honours or A standing). Thus, finding a model that accounts for slightly more than 30% of the variance in performance in a very homogeneous group is considered significant (Norman & Streiner, 1994).

The findings of the present study support retaining both science and humanities courses as prerequisites to the program. High school English and chemistry grades emerged as predictive of success on the professional examination, consistent with a prior study (Horns, O'Sullivan, & Goodman, 1991). English courses may contribute to comprehension and writing skills, as well as "habits of analysis and reflection, introspection and self-examination" (Levine, 1995, p. 22). This conclusion is supported by the finding that nursing theory courses, in which personal writing and presentation skills are the outcome measure, were more predictive of success on the CNATS (a written examination) than were the clinical courses. Graduates of PBL curricula may perform better on "measures of humanism" (Vernon & Blake,

1993). During the tutorial process (PBL), a balance of science and humanism is brought to analysis of nursing situations, an outcome that the CNATS is designed to measure.

The analytic and problem-solving skills acquired in science classes may prepare students for critical problem-solving in nursing study and practice. The finding that science courses were a strong predictive variable of success on the CNATS, both as an admission variable (OAC chemistry) and as an in-program variable (human biological science and research methodology), supports the conclusion that these skills are used in writing these examinations. Although OAC biology was not considered a separate variable, because it is not a program requirement, the NEWADMAV for most of the study subjects contained additional science courses. Students who do well in both English and chemistry may have a particular facility for combining the scientific and humanistic aspects of nursing.

Early identification of students who will be unsuccessful academically is an important issue for nursing programs (Heupel, 1994). The basic sciences and the first-year nursing course were demonstrated to be early program predictors of success on the CNATS examinations. The greater contribution of theory courses (PBL in this curriculum), as compared with clinical grades, for predicting CNATS scores is consistent with other studies (Krupa, Quick, & Whitley, 1988). One study showed that science courses based on didactic principles relate well to nursing theory courses that require a high level of conceptual thought (Jacono et al., 1987). It is possible that the intellectual skills acquired in science and nursing theory courses are particularly useful in writing the CNATS examination.

The globally reported failure rates for the B.Sc.N. program for the years of the study ranged from 5% in 1992 to 10% in 1993, while the failure rate within the study sample ranged from 5% (2 of 36 subjects) in 1991 and 1992 (2/38) to 12.5% (5/40 subjects) in 1993. Although this is higher than the overall national standardized rate of 4%, the success rate was somewhat more stable over the years of the study than that reported in the results of a study by another Canadian university school (Jacono et al., 1987). Furthermore, the success rates of the entrants from high school closely resemble the success/failure rate among the "other qualifications" applicants; this finding differs from that of Froman and Owen (1989), who report a higher success rate among older students.

It is evident that most students admitted to the B.Sc.N. program using the present criteria successfully complete the educational program and are successful in their first attempt at writing the CNATS

examination. The 88% success rate of graduates on the examination may be attributable either to program variables or to stringent admission criteria. A move to criterion-referenced examinations may produce results different from those of the present study, and will thus require further research. One of the characteristics of a PBL-based curriculum is that students may not write regular formal examinations, as they do in traditional curricula; this may be a disadvantage for graduates, who then have to take a traditional multiple-choice examination. In 1991 the B.Sc.N. program introduced a voluntary practice examination to prepare the students for the experience of writing standardized examinations. This may have contributed to the stability of the failure rate during the years of the study. Further research will be conducted to determine the outcomes of these practice examinations and the relationship of success on these examinations and subsequent CNATS examinations.

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