

# PREDICTORS OF SUCCESS IN R.N. LICENCE EXAMINATION

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The usual outcome criteria against which schools of nursing science are measured are the graduation of their students, and their success in getting licensed to practise. Unfortunately not all graduating students obtain this licence - at least not on their first attempt. In a volatile marketplace characterised by peaks and troughs in personnel availability, some may view these first time failures as usurpers of limited access-to-programme places. Others note the potentially significant loss of revenue to the unsuccessful graduate, and the loss of one more professional to the system. These problems on their own would seem important enough to generate some attention to predictors of success on registration examinations.

As the literature review that follows will indicate, previously published material on the subject reveals that study of the problem was predominantly American based. Non-baccalaureate programmes have come under scrutiny more often than baccalaureate programmes. In addition, most of the studies reviewed concentrated their attention on predictors of success in graduating from a programme, rather than predictors of success in obtaining a licence to practise. All of this then, would seem to be another factor suggesting that this area might need further exploration in a Canadian context. When the authors noted the above, and significant fluctuation in failure rates among Laurentian University students across the years 1978 to 1986 (Table 1), they were prompted to carry out this study.

*Change* { Statistics about the presence or absence of similar fluctuations in failure rates in other schools of nursing science were impossible to obtain. However, in our case, we noted that when the framework for the licensing examination changed from a medical model to a comprehensive framework (in August, 1980), the failure rate for Laurentian University students decreased. In spite of the fact that entrance requirements have been consistently upgraded, the failure rate shows a recent uptrend. (Table 1). In addition, while the annual Canadian failure rate is only 4%, (because examination results are standardised), the ratio (baccalaureate to diploma prepared nurses) of these failures is unavailable.

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**Table 1**

***Failure Rate (%) in Obtaining a Licence to Practise (R. N.) at First Attempt. Nursing Science Students at L. O. by Year.***

Year	Number Writing*	Number Failing	%Failing
1978	16	3	18.7%
1979	18	3	16.7%
1980	26	8	30.7%
1981	17	0	0.0%
1982	16	0	0.0%
1983	13	0	0.0%
1984	26	0	0.0%
1985	39	3	7.7%
1986	49	6	12.2%

\* Includes transfers, second degree as well as students admitted to programme directly from high school.

These factors collectively suggested that the whole area of predictors of success in registration examinations merited further investigation.

### **Problem Definition**

This study was designed to identify those factors of importance in success on the licensing examination. It also was designed to identify predictors of success in the programme itself. All students writing registration examinations must be graduates of a nursing programme, and as such success in the programme here refers to the hierarchical rank of the students' grades. Success on the registration examination, on the other hand, was looked at both in terms of actual grades as well as pass/fail categories. It was hoped that by identifying both predictors of programme success and of licensing examination success, commonalities might emerge that would allow for better identification of those students who would be most likely to succeed in both outcome criteria for nursing programmes.

### **Literature Review**

The High School Grade Point Average (G.P.A.) has often been considered a good predictor. Sharp (1984) found significant correlations between high school G.P.A. and success or failure on licensing examinations. However, significantly more robust correlations emerged when this variable was united with other "cognitive" variables. Dell and Hapin (1984) appear to confirm

these findings, in addition they stated that the high school G.P.A. was a better predictor of success in the programme than success in obtaining a licence to practise. This had also been confirmed previously by Tillinghast and Norris (1968).

An increasing emphasis in the "science" aspect of nursing science programmes, has resulted in particular Grade 13 courses being assigned more weight (value) in admission parameters. Not surprisingly these subjects are science courses. No study that considered particular pre-requisite to entry-to-programme courses as predictors of success could be found. However, Weinstein, Brown and Wahlstrom (1980) found that performance in high school English and the number of pure or applied science courses taken, were good predictors of success in a diploma programme. The results of pure and applied science courses (on their own), were the best predictors of success.

Some studies reviewed, in addition to the high school G.P.A. also examined the effects of the grade point average obtained by the student in all nursing courses taken in the programme; of the cumulative grade point average calculated on all courses taken during the programme; of the grade point average on specific nursing/non-nursing composite groupings; and of the grade point average for specific programme years or semesters.

As will be indicated, the results of these studies have been varied at best. Melcolm, Venn and Blausell (1981) found few significant correlations between cumulative averages and results on the licensing examination. For this reason alone, this area merits further investigation. In addition, Yocom and Scherubel (1985), further found that grade point averages for certain programme years (sophomore, junior, and senior), were statistically significantly correlated to licensing examination results. This latter finding may help explain some of the different findings for the various studies.

Review of studies that considered grade point averages in nursing courses as predictors of success in obtaining a licence to practise, once again, revealed variable results. Yocom and Scherubel (1985) elicited significant correlations between grade point averages attained on all nursing courses and success on licence examinations. These relationships had previously been proposed by Dell and Hapin (1984). However, Melcolm, Venn and Blausell (1981) had previously found that grades obtained in Nursing Theory courses were better predictors of success than those in Clinical Nursing courses. The problem is further compounded by reported statistically significant relationships between other non-nursing courses (usually taken as required courses in a programme), and success on licence examinations. Clemence and Brinks (1978) are an excellent case in point. They reported that Introductory Psychology, Developmental Psychology and Abnormal Psychology, were not only related to success or failure on license examinations, but also appeared to be good indices of

success in the programme itself. They further reported that Sociology was associated with success or failure on licence examinations, but not to the level of success (hierarchical ranking) on these examinations. Finally, their data suggested that Physics was related to the length of time it took a student to finish the programme satisfactorily but not to success or failure on licence examinations; Anatomy and Physiology were related to B.Sc.N. programme completion and success or failure on licence examination but not to programme success. Clearly, while information on the topic is substantial, results published are not readily usable as a source of guidance. Work by one of the authors on a provincial accreditation committee confirmed a substantial uniformity of curriculum in Canadian B.Sc.N. programmes. This then seemed to make our task somewhat easier and our results more applicable.

### *The Population*

The target population for the study was all students who had graduated from the Laurentian University school of Nursing Science and had written licensing examinations between 1978 and 1986. The total population was 220 students. This population was mixed (some students had entered the programme directly from high school, some had transferred from other universities or from other programmes, while others were second degree students), therefore potential confounding variables were eliminated through inclusion/exclusion criteria. Subjects were included in this study if they had been admitted to the programme directly from their high school experience, and if they were writing their licensing examination for the first time. The sample then was made up of 121 students from a potential pool of 220 students.

### **Method**

Students records obtained from the university's Registrar of Admissions were examined to obtain the following information;

1. High school marks in Chemistry, Biology, English/French and three other subjects of choice presented by the student for consideration-to-admit to the programme.
2. A grade point average obtained in the completed B.Sc.N. programme.
3. A grade point average for all nursing courses taken in the programme.
4. A grade point average for courses deemed to include a high degree of theoretical/conceptual content.
5. Terminal marks in Biology courses, Chemistry courses, and Psychology courses.

In addition, the mark(s) obtained in the R.N. licensing examinations were obtained for the licensing body. For students writing comprehensive examinations, their success on the examinations was looked at in terms of pass/fail and

actual scores obtained. For those students who wrote licensing examinations prior to the change over in August of 1980, success was looked at in terms of pass/fail as well as the mean grade for the five components of the examination. By definition, this study was limited to information obtained from the records of students enrolled in one school of nursing science during a previously defined period. The marks registered in each of these categories govern the students' progression, thus they must be assumed to be reliable. Their predictive validity is assumed, and therefore they are included as variables.

Data were subjected to factor analyses, discriminant function analyses, analyses of variance and descriptive statistical techniques.

## Results

The sample was composed of 121 students (119 females, 2 males) ranging from 18 to 23 years in age at admission to the programme with a mean of 19.1 years. 1974 was the first admission year included in the study, and 1982 the last programme year included. Of these students, 107 (88.4%), obtained their licence on the first attempt, while 14 (11.6%) required subsequent attempts.

The first and perhaps most important question that needed answering related to the reliability and validity of entry to programme criteria. In other words, do Grade 13 marks on a variety of subjects (some required, some elective), give admission to programme committees some indication of potential for success? Table 2 suggests that, using this information alone, some 32% of all applicants would have been incorrectly classified. Moreover, an Eigenvalue of less than 0.1, in association with a Wilk's Lambda of 0.9370423 confirms that these criteria account for less than 10% of the variance explaining success or failure in the R.N. examination. Clearly Grade 13 Biology, Chemistry, English/French and three other subjects of choice were poor criteria for entry to programme determination if the terminal objective is to predict success in getting licensed on the first attempt. This is further confirmed in Table 3 which

**Table 2**

*Efficiencies of Discriminant Functions of Grades in All Admission to Programme Subjects as Predictors of Success or Failure on R.N. Examinations.*

Actual Status (n)		Predicted Status		Correctly Classified (%)
		Success (%)	Failure (%)	
Success	107	69 (64.5%)	38 (35.5%)	66.94%
Failure	14	2 (14.3%)	12 (85.7%)	

**Table 3**

***T-Test Between Means of Grade 13 Marks in Subjects Used as Criteria for Admission into B.Sc.N. Programme.***

Var. Groups	(n) of Cases	Mean	F Value	2 Tail Probab.	Pooled Variance Estimate			Seperate Variance Estimate			
					T Value	(D.F.)	2 Tail Probab.	T Value	(D.F.)	2 Tail Probab.	
Chem.	F	14	67.5714	1.65	0.313	-1.30	119	0.197	-1.57	19.1	0.132
	S	107	70.7383								
Biol.	F	14	75.0714	1.18	0.612	-0.41	119	0.682	-0.39	16.0	0.705
	S	107	76.0093								
G.P.A.	F	14	73.6429	2.31	0.091	-0.32	119	0.753	-0.43	21.8	0.669
	S	107	74.1308								

Group S- Success on R.N. exam  
 F- Failure on R.N. exam

indicates that the differences between means of both the successful and unsuccessful groups were not statistically significant.

Admission to the programme must be and is based on previous academic performance, as such, these indices must have some value. Table 4 is a correlation matrix of all the variables in the study. Admission G.P.A. (the average of six Grade 13 courses), is significantly related to all the other variables in the study ( $p < 0.05$ ). The relationship of Admission G.P.A. to results on the R.N. examination is only marginally significant ( $p = 0.042$ ), while all of the other variables are significant at  $p < 0.01$ . Additionally, both Grade 13 Biology and Chemistry, examined in isolation, are significantly related to other variables included. A note of caution must be introduced here. Intuitively, preparation in Chemistry and Biology would be strongly related to university level courses in the same subjects. In reality, Grade 13 Chemistry accounts for only 13% of the variance in Organic Chemistry and 6% in Biochemistry. Similarly, Grade 13 Biology explains only 13% of the variance in Anatomy, 12% of the variance in Micro-biology and 18% of the variance in Human Physiology. Interestingly, Grade 13 Biology appears to explain 23% of the variance in all nursing courses. They are however as suggested, not a good predictor of success in obtaining a licence to practise.

It would also appear from results exhibited in Table 4 that science-based courses requiring systematic didactic principles relate well to courses that require a high degree of conceptual thought. In particular, Anatomy, Physiology, Micro-biology and Developmental Psychology individually explain more than 30% of the variance in conceptual thought courses. Conceptual thought courses include Concepts of Illness, Issues in Nursing, Nursing Theory, Epidemiology, Biostatistics and Research. Neither the three Grade 13 elective

Table 4

*Pearson's Correlation Coefficients (r) Between Variables Studied and Marks Obtained on the R.N. Examination (n = 121 Students).*

	Anatomy	Organic Chemistry	Intro Psych.	Micro-Biology	Human Physiol.	Bio-Chemistry	Develop. Psych.	Nursing Courses	Concept Courses	R.N. Exam
Admission G.P.A.	**	**	**	**	**	**	**	**	**	*
Grade 13 Chemistry	0.5609	0.5203	0.3834	0.4768	0.5685	0.4624	0.3702	0.5582	0.5172	0.1820
Grade 13 Biology	**	**	**	**	**	**	*	**	**	*
Anatomy	0.3620	0.3552	0.2731	0.3635	0.3658	0.2502	0.1753	0.2743	0.2521	0.0929
Organic Chemistry	**	**	**	**	**	**	**	**	**	*
Introductory Psychology	0.3590	0.4440	0.3298	0.3523	0.4248	0.3278	0.4029	0.4816	0.4162	0.2134
Micro-biology	1.0000	**	**	**	**	**	**	**	**	**
Human Physiology	1.0000	0.7098	0.5489	0.6994	0.6858	0.5796	0.4429	0.6445	0.5801	0.3093
Bio-chemistry		1.0000	**	**	**	**	**	**	**	**
Developmental Psychology			1.0000	**	**	**	**	**	**	**
Nursing Courses G.P.A.				1.0000	0.5647	0.4116	0.5094	0.5511	0.4932	0.5196
Conceptual Courses					**	**	**	**	**	**
B. Sc. N. Prog. G.P.A.					1.0000	0.7604	0.5216	0.5469	0.6618	0.5797
						**	**	**	**	**
						1.0000	0.6461	0.5275	0.7523	0.6861
							**	**	**	*
							1.0000	0.4451	0.6118	0.5359
								**	**	**
								1.0000	0.6337	0.5530
									**	**
									1.0000	0.8649
										0.5383
										**
										**
										1.0000
										0.4449
										**
										0.5283

\* p ≤ 0.05

\*\* p ≤ 0.01

courses, nor mother tongue were included in this matrix, because the elective courses included a large variety of subjects. Mother tongue was problematic because, until recently, most courses have been delivered in English. The applicant then would have had to be comfortable working in the English language. Most courses at Laurentian University are now available in both official languages.

**Table 5**

*Factor Analysis on Independent Variables.*

Variables	Factor 1 General	Factor 2 Grade 13	Factor 3 Language
B. Sc. N. Programme G.P.A.	.94969		
Nursing Courses G.P.A.	.88367		
Human Physiology	.87033		
Micro-biology	.82203		
Anatomy	.81967		
Conceptual Content Courses	.80651		
Organic Chemistry	.80112		
Introductory Psychology	.71616		
Admission G.P.A.	.71025	.57550	
Bio-chemistry	.71018		
Developmental Psychology	.69441		
Grade 13 Biology	.57879		
Grade 13 Chemistry		.64058	
English Mother Tongue			.63997
French Mother Tongue			-.73603

Only Factors Loading  $\geq 0.50$  used

Independent variables were submitted to factor analyses. Only variables with an Eigenvalue equal to or greater than 0.5 were included. This technique yielded three factors exhibited in Table 5. Not surprisingly, the most robust loadings (Eigenvalue  $> 0.8$ ), in the larger of the three factors included the Programme G.P.A., Nursing courses G.P.A., Physiology, Microbiology, Anatomy, Concept courses G.P.A. and Organic Chemistry. Examining these courses (but excluding Grade 13 courses already dealt with), Table 6 illustrates the significance of differences between means for these variables, obtained by successful and unsuccessful candidates. The between-group variance ( $p < 0.06$ , two-tailed), for Micro-biology, Programme G.P.A., and Nursing content courses were significantly different. In relation to Organic Chemistry, Bio-chemistry, Anatomy, Human Physiology, Introductory Psychology, Developmental Psychology and conceptual content courses, the between-groups variance was not statistically significantly different. The "t" value for Separate

Variance Estimate however, suggests that successful candidates obtained higher marks than unsuccessful candidates in Organic Chemistry, Human Physiology, Introductory Psychology, Developmental Psychology, and conceptual thought courses. There appears to be no difference between or within groups in relation to Bio-chemistry and Anatomy.

**Table 6**

***T-Test Between Means of B.Sc. N. Programme Subjects Taken by Students Successful/Unsuccessful in the R.N. Examination***

Var.	Groups	(n) of Cases	Mean	F Value	2 Tail Probab.	Pooled Variance Estimate			Seperate Variance Estimate		
						T Value	(D.F.)	2 Tail Probab.	T Value	(D.F.)	2 Tail Probab.
Organic Chemistry	F	14	67.5714	1.34	0.567	-2.91	119	0.004	-3.26	17.9	0.004
	S	107	73.3084								
Bio-Chemistry	F	14	67.2857	1.71	0.275	-0.48	119	0.634	-1.58	19.4	0.564
	S	107	68.7570								
Anatomy	F	14	70.1429	1.25	0.686	-1.45	119	0.149	-1.58	17.5	0.131
	S	107	73.3925								
Micro-Biology	F	14	59.2857	2.93	0.033	-4.07	119	0.000	-6.07	24.5	0.000
	S	107	69.6729								
Human Physiology	F	14	56.0714	1.72	0.269	-4.26	119	0.000	-5.25	19.4	0.000
	S	107	68.1495								
Introductory Psychology	F	14	66.2857	1.10	0.731	-4.51	119	0.000	-4.34	16.2	0.000
	S	107	75.6262								
Developmental Psychology	F	14	70.7857	1.26	0.675	-1.84	119	0.068	-2.01	17.6	0.059
	S	107	74.3178								
Program Average	F	14	70.2571	2.62	0.054	-2.78	119	0.006	-3.99	23.1	0.001
	S	107	73.8234								
Nursing Courses	F	14	71.4929	3.08	0.026	-2.38	119	0.019	-3.60	25.1	0.0001
	S	107	74.4000								
Concept Courses	F	14	72.2143	1.64	0.316	-1.69	119	0.094	-2.04	19.1	0.055
	S	107	74.6822								

Group: S- Success on R.N. exam  
F- Failure on R.N. exam

The data then suggest that successful candidates tend to score significantly higher than unsuccessful candidates in Micro-biology and nursing courses and tend to have a higher programme G.P.A. In addition, the successful candidates, examined separately, tend to score higher than their unsuccessful peers in

Organic Chemistry, Human Physiology, Introductory Psychology, Developmental Psychology and conceptual content courses. Neither Bio-chemistry nor Anatomy seem to indicate differences between these two groups.

The three factors elicited from factor analyses (Table 5) were labelled "General" (Factor 1), "Grade 13" (Factor 2), and "Language" (Factor 3). These factors were submitted to discriminant function analyses with the results of the R.N. examination as the dependent variable. Table (7) demonstrates the efficiencies of these factors in predicting success/failure in obtaining a licence to practise. Patently, the strongest predictor (89.26% correct classification), is Factor 1. Both Factors 2 and 3 approach the pure chance level of predictive value. More importantly, while Factors 2 and 3 manage to explain less than 1% of the variance (Wilk's Lambda = 0.98211, 0.98922), Factor 1 explains 34% of the variance.

**Table 7**

***Efficiencies of discriminant Functions of Factors Predicting Success or Failure on R.N. Examinations.***

Variable	Actual Status	(n)	Predicted Status		Correctly Classified (%)
			Success (%)	Failure (%)	
Factor 1	Success	107	97 (90.7%)	10 (9.3%)	89.26%
	Failure	14	3 (21.4%)	11 (78.6%)	
Factor 2	Success	107	66 (61.7%)	41 (38.3%)	61.16%
	Failure	14	6 (42.9%)	8 (57.1%)	
Factor 3	Success	107	58 (54.2%)	49 (45.8%)	54.55%
	Failure	14	6 (42.9%)	8 (57.1%)	
	Eigenvalue	Correlation	Wilks' Lambda	X <sup>2</sup>	Significance
Factor 1	0.51661	0.58364	0.65937	46.854	0.0000
Factor 2	0.01822	0.13375	0.98211	2.1301	0.345
Factor 3	0.01090	0.10382	0.98922	1.2788	0.5276

## Conclusions

Like all other authors, we aimed to produce the definitive source of guidance for our colleagues facing annual dilemmas. Probably, like them, we too have failed to account for the multiplicity of confounding factors that conspire to make human nature difficult to predict. Candidates applying for first time entry into the programme have to be admitted on the basis of some criteria, in particular because large numbers vie for limited space. At Laurentian University, the Grade 13 grade point average provides the first selection hurdle, with marks in chemistry and biology providing further delimiters. Analyses discussed above suggest that admission grades are not particularly good predictors of success in obtaining a licence to practise; but do in fact correlate well with first and second year performance in the programme. This is probably no more than can be asked of these criteria. When it comes to predicting success in the R.N. examination, most of the subjects taken during the four-year programme contribute. In particular, our groups were differentiated on the basis of marks obtained in Organic Chemistry, Micro-biology, Human Physiology, Introductory Psychology, Developmental Psychology, nursing content courses, conceptual content courses and, of course, the programmes' terminal grade point average. Even so, the clearest between-group differences were produced by only three variables: Micro-biology, nursing content courses and terminal programme grade point average.

In the final analysis, each student is allowed to take the R.N. licensing examination once they have satisfactorily completed their programme. Satisfactory completion of the programme is based on grade point averages set by the university issuing the degree. One could consider withholding permission to write the R.N. exams if the grade point average (although sufficient to earn a university degree) may not be deemed sufficient to allow one to write the licence examination. This we feel would make a mockery of a quintessentially humanistic science, and would probably be successfully rebutted in the courts. In addition, there does not seem to be any evidence that marks obtained in a programme teaching nursing science translate into quality care at the bedside.

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## RÉSUMÉ

### **Indices de prévision de succès aux examens de permis d'exercice des infirmières et infirmiers.**

Les antécédents scolaires de 121 diplômés du programme de B.Sc.N. auquel ils avaient été admis directement ont été examinés. Les matières choisies en 13<sup>e</sup> année, présentées comme preuve d'aptitude à l'admission au programme, ne se sont pas avérées de bons indices de prévision du succès ou de l'échec à l'examen de sciences infirmières. Elles peuvent toutefois être de bons indices des résultats qu'obtiendront les étudiants au cours des deux premières années du programme. Les matières qui ont le mieux permis de distinguer les étudiants qui ont réussi des candidats qui ont échoué ont été la microbiologie, les cours de sciences infirmières; la moyenne des notes pondérées du programme de B.Sc.N. y a également contribué.