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Selection criteria for a radiography programme in South Africa: Predictors for academic success in the first year of study

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ABSTRACT

Background: Selection criteria used to admit students to a radiography programme at the Central University of Technology (CUT) included academic criteria, as well as the General Scholastic Aptitude Test (GSAT) and Self-directed Search (SDS) Questionnaire.

Aims and objectives: The aim of the study was to identify which selection criteria were predictors of academic success in the first year of study. As a four year Bachelor's degree in Radiography (480 credits) was to replace the three year National Diploma (NDip) in Radiography (360 credits), selection criteria would come under review.

Design and method: Data from 130 students were gathered in a retrospective quantitative study. Data were edited, categorised and summarised. A statistical analysis was undertaken to identify which selection criteria predicted academic success in the first year of study.

Results: Statistics showed that the matriculation Admission Points Score (National Senior Certificate/NCS APS) and core matriculation subject results in Mathematics, Physical Sciences and English were adequate predictors for first-year academic success, and the subjects Life Sciences for the NSC and Biology for the Senior Certificate (SC), showed strong predictive values for first-year academic success. According to the statistical analysis, the GSAT and SDS Questionnaire did not contribute any significant information which could predict academic success.

Conclusion: Matriculation marks and NSC APS were adequate predictors for academic success, with a focus on Life Sciences or Biology marks as the strongest predictor. The usefulness of the GSAT and SDS Questionnaire could be questioned, and a recommendation was made to replace these tests with alternative student selection methods.

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1. Introduction

At the time of this study, the selection criteria used to admit students to a three year radiography programme, the National Diploma in Radiography (360 credits) at the Central University of Technology (CUT), in Bloemfontein, South Africa included academic criteria, as well as the General Scholastic Aptitude Test (GSAT) and Self-directed Search (SDS) Questionnaire. During 2010, the Health Professions Council of South Africa (HPCSA) and the South African Qualification Authority (SAQA) approved and registered a four year professional Bachelor's degree in Radiography (480 credits), on a level 8 of the Higher Education Qualification Sub-Framework (HEQSF, 2013:online), and according to the National Qualification Framework (NQF) guidelines (NQF, 2013:online). The South African Bachelor's degree in Radiography included an additional exit-level outcome where the graduate should demonstrate research skills in radiography (HPCSA 2013a:online), indicating that additional academic competencies would be required from students at degree level education. Authors Ng, White, and McKay (2008:256) highlight the need for both academic excellence and professional competence in an undergraduate radiography programme, stressing that degree programmes need to ensure both the academic development of skills such as analysis and critique, as well as improved practice skills. An assessment of the selection criteria as predictors of academic success, particularly for entry level students in the current radiography programme was considered relevant.

1.1. *Literature review*

Research into selection criteria for radiography education in other countries such as Kenya, showed that both diploma and degree level radiography education is available, and there is an articulation from the three year diploma level programme to degree level (JKUAT, 2015: online). Selection criteria in Kenya include academic achievement in core subjects. Other countries such as Australia, offer only degree level education and academic achievement in English, Mathematics and Physics is a prerequisite for admission to the Bachelor of Medical Imaging degree at Central Queensland University (CQU) (CQU, 2015: online). In the United Kingdom (UK), achievement in Mathematics, Science, Biology and English is a prerequisite for admission to Bachelor of Science in Diagnostic Radiography programme, where prospective students also undergo an interview, to establish whether they demonstrate "the right values to support effective team working and excellent patient care and experience" (Derby University, 2015: online). Additionally a disclosure and barring service (DBS) to disclose any criminal record in the UK helps selection panel members make safer recruitment decisions (2015: online).

1.2. *Background*

Against the background of the proposed transition from diploma level to degree level radiography education, an assessment of selection criteria for diploma level radiography education at the CUT during 2010–2012 was considered relevant. A statistical analysis of the above selection criteria as performance predictors could assist selection panel members in selecting students most likely to succeed in the programme, as only a limited number of students could be accommodated annually. It could also help to identify the best practice for a future radiography programme selection process in South Africa.

Selection criteria do not stand alone in predicting the academic success of the student. It is also recognised that numerous additional factors, such as the availability of finances, student living conditions, socialisation factors, time management and dedication to studies, all play a role in the academic success or failure of the entry level student. Additionally, it is recognised that institutional intervention strategies which assist students to achieve academic success also have a positive contributing role. All registered CUT students write an Academic Language Proficiency (ALP) test at the commencement of their first academic year. This is in line with other tertiary institutions, where academic literacy tests serve as "diagnostic measures of students' learning and thinking capacities and shortcomings at this early stage of their studies" (Cliff & Hanslo, 2009:269).

All first-year students at the CUT were also expected to complete a credit-bearing English Proficiency module, unless they had evidence of credits in a language proficiency module in English at another institution of tertiary education. This module was intended to equip the student with the necessary language proficiency required for studies in tertiary education (CUT, 2013a, 2013b:online). In other intervention strategies at the CUT, entry level students identified as being "at risk" after the first cycle of formative assessment tests, may be advised by educators or student counsellors to enrol in modules such as the Academic Literacy module and a Personal Competencies and Life Skills module, which include guidance in effective study methods, critical and creative thinking skills, and analytical decision-making skills (CUT, 2013a, 2013b:online).

Firstly, to consider how radiography students in this study were initially selected for the programme and secondly, to assess their academic performance in a radiography context where the practical competence of graduates is highly rated, may provide useful information for future student selections. A reflection on discipline-specific contexts may help answer questions related to student selection and admittance to institutions of higher education in South Africa. Cliff, Ramaboa, and Pearce (2007:33) considered the following questions in their research: (i) whether an understanding of students' academic literacy levels (through an initial assessment thereof) had a consequence for teaching and learning and ultimately the academic performance of the student; and (ii) whether "generic levels of academic literacy" could be related to academic performance in discipline-specific contexts.

In a recent South African study, authors Mashige, Rampersad, and Venkatas (2014:550) considered whether National Senior Certificate (NSC) results could predict first-year academic performance amongst Bachelor of Optometry students at the University of KwaZulu-Natal, South Africa. The study focused only on first-year students who had written the National Senior Certificate (NSC) examination, and did not consider other groups of students who had prior tertiary

education. The study found a weak correlation between the NSC Admission Points Score (NSC APS) and the students' first-year average scores. They also determined that subjects such as NSC Mathematics, Physical Sciences and Life Sciences, were weak predictors for academic success at university entry level in the field of Optometry.

1.3. *Radiography student selection in context*

In the current study, all students in their first year of study in the radiography programme were included, firstly the group of students who were recent school leavers and who had written the NSC, and secondly the group of slightly older (mature) students who had written the Senior Certificate (SC) in 2007 and prior. The 2010–2012 minimum requirements for selection to the radiography programme at the CUT included a minimum score of 27 on the CUT admission points score (CUT APS) rating scale, which had levels equivalent to those of the more widely used NSC APS. The NSC APS is assigned according to achievement in each of the subjects written by the candidate in the school-leaving examination. For prospective students who completed the NSC in 2008 or in subsequent years, academic weights for achievement, according to the CUT scoring scale, are shown in Table 1.

In line with strategies to accommodate students in an equitable manner, as described by Badat (2011:5), there are also provisions to select students who have matriculated in 2007 or earlier. According to the CUT admission requirements, candidates who matriculated in 2007 or earlier, and who did not obtain the required 27 points on the CUT APS rating scale, but between 20 and 26 points, could undergo a test to determine their potential (CUT, 2013b:online). These students could still be eligible to qualify for admission provided that there was place in the programme. A system of bonus points added to their CUT APS made admission possible. To calculate the CUT admission points score for prospective students who matriculated in 2007 or earlier with a Senior Certificate (SC), a value is allocated to the symbol obtained in a subject, and the values according to the symbols obtained in the examinations are added together to calculate the total score, as shown in Table 2.

In addition to the above academic admission requirements, the selection criteria for the diploma level radiography programme also included an Achievement Level requirement of 3 (40–49%) in English, Life Orientation and Mathematics. A further required Achievement Level 4 (50–59%) was required for core subjects Physical Sciences and Life Sciences (CUT, 2013b:online).

At the time when the study was conducted, prospective students were also expected to undertake further selection tests at the CUT, including psychometric tests provided by the Human Sciences Research Council (HSRC) of South Africa, endorsed by the Professional Board for Psychology of the HPCSA. These tests included a General Scholastic Aptitude Test (GSAT, HSRC Test Reference Number 18/11/18), and a Self-Directed Search (SDS) Questionnaire (an HSRC-condoned test with no listed reference number, Form 207 2009) (HPCSA, 2013b:online). The students also undertook an English Proficiency Test as part of the selection process. Both the school-leaving academic scores and the alternative selection test scores were used according to a specific formula to calculate an overall total CUT rating score, which was used to select students for the radiography programme.

According to Cliff et al. (2007:34), selection tests (also known as admissions tests or entrance tests) were a means of "collecting information" about applicants rather than using only academic criteria, such as school-leaving examinations. The authors also emphasised the need for "responsible, ethical and equitable approaches to admissions decisions", and further stressed that "there is a clear need to assess the outcomes of the use of multiple selection criteria on the academic progression of students thus selected" (Cliff et al. 2007:34).

Cognisant of the above recommendations, the predictive ability of the GSAT as selection tool is considered in the current study. A previous study by Jenkings (2004:78), at the institution then known as the Port Elizabeth Technikon, considered the predictive validity of the GSAT for entry level Information Technology students at the institution. The GSAT was found to have some predictive ability in academic success, but school-leaving marks were considered to have better predictive ability. Other factors were also found to play a role in academic success, and the author stated that "the potential of the tests lies in providing access to students who may otherwise have been excluded from programmes based on other selection criteria". As a result of his research, Jenkings recommended both academic support and correct placement

Table 1 – The scale used for the calculation of CUT admission points score (APS) according to the NSC results for matriculation from 2008 onwards (CUT, 2013b).

NSC result for matriculation	CUT APS
90–100%	8
80–89%	7
70–79%	6
60–69%	5
50–59%	4
40–49%	3
30–39%	2
0–29%	1

Table 2 – The scale used for the calculation of CUT admission points score (APS) according to matriculation results in 2007 and earlier (CUT, 2013b).

Symbol obtained in Grade 12 subjects	CUT APS
Subject on higher grade	
A	8
B	7
C	6
D	5
E	4
Subject on standard grade	
A	6
B	5
C	4
D	3
E	2

of students in programmes. The recommendation for academic support is now widely used at institutions of higher education in South Africa in the form of extended curriculum programmes and interventional strategies. The latter recommendation—the correct placement of students in programmes—is significant, as it highlights "a great need for comprehensive career counselling as part of the selection process", which may be an area still requiring further development, even a decade later (Jenkings, 2004:78).

Comprehensive career counselling, the suitability of a prospective student to a given career path, is particularly relevant in an allied health sciences profession such as radiography. By providing applicants with an opportunity to access the healthcare environment in which they will work, may help prospective applicants to make an informed decision. Through a process of self-reflection, prospective applicants draw their own conclusions about their suitability for the profession. A succinct example of required attributes of a radiographer can be sourced from the City University of London's radiography programme (CUL, 2013:online). Prospective students are informed that radiographers "(1) should be good at dealing with people and have the ability to reassure ill or agitated patients; (2) should have an interest in scientific subjects; and (3) should show confidence in using very costly technological equipment. Furthermore, they should be able to be (4) adaptable and (5) make quick decisions in clinical situations using critical thinking" (CUL, 2013:online).

At the time of the study, another alternative selection test for prospective radiography students at the CUT was the SDS questionnaire. This is an interest inventory used for career counselling purposes, and is derived from a structural model of vocational personality types developed by Holland as described in Du Toit and De Bruin (2002:63). This model is also known as the R-I-A-S-E-C model and includes "Realistic (R), Investigative (I), Artistic (A), Social (S), Enterprising (E), and Conventional (C) vocational personality types" (Du Toit & De Bruin, 2002:63). The questionnaire is aimed at making predictions about the relationships between the different vocational types, with the aim of aiding a student in making a career choice. Du Toit and De Bruin (2002:75) did not find structural validity of the model in the South African context. They considered the fact that because the questionnaire was in English, and the English language was the second and even third language of the respondents used in the study, it may have influenced the results. The authors expressed the view in their study more than a decade ago that further investigation might be necessary, and that participants should have the opportunity to answer the SDS questionnaire in their first language in order to understand their interests and vocational personalities more clearly. The conclusion was drawn that "if a poor fit is still obtained in such *further* studies, the validity of interest inventories that are based on Holland's circular order model in the South African context would have to be questioned" (Du Toit & De Bruin, 2002:75, emphasis added).

2. Aim

The aim of this retrospective study, undertaken at the CUT, was to assess the selection criteria for a diploma level radiography programme and to determine whether the criteria served the purpose of selecting students most likely to succeed in this programme.

The objective of the study was to undertake a statistical analysis in order to identify which of the selection criteria could predict academic success in the first-year of study in diploma level radiography education. The information gained could be useful in determining best practice for a future selection process in radiography education.

3. Methods

A retrospective quantitative study was conducted, using data from all 130 first-year students enrolled in the NDip in Radiography at the CUT over a three-year period. Permission to conduct the study was obtained from the relevant authorities at the CUT, and ethical approval (ECUFS no 36/2013) was obtained from the Ethics Committee of the Faculty of Health Sciences, University of the Free State.

3.1. *Design*

The data for each student included relevant demographical information, the NSC APS, the CUT APS , bonus points awarded and individual matriculation core subject scores. It was established whether the student had written a matriculation Senior Certificate (SC) or a National Senior Certificate (NSC) and the scores for each subject were recorded. The selection tests, GSAT, English Proficiency, SDS Questionnaire and the total CUT rating scores were also recorded. These scores were correlated with the first-year academic results in the radiography programme.

3.2. *Data collection method*

A data collection sheet was used to record the marks achieved in each of the following entry-level modules: Radiographic Practice (Theory), Clinical Radiographic Practice, Radiographic Pathology, Radiographic Image Recording, Physics, Anatomy, Physiology and Psychodynamics of Patient Care. The total average mark for all modules was calculated, and progression to the second year of study was recorded.

3.3. *Data analysis*

The data were edited, categorised and summarised. Statistical analyses, including Pearson's r, were used to test the correlation between selection tests, student academic marks in entry level radiography modules, and the total average entry level radiography mark. A linear regression analysis was done to assess the relationship between variables in this study. A linear regression, in addition to the correlation analysis, made it possible to identify which variable in this study could be considered to be the best performance predictor.

The advantage of using a coefficient of determination, such as that provided by linear regression, is that it provides a "proportional reduction in error measure" (Burdess, 2010:89). Burns and Grove, in Botma, Greeff, Mulaudzi, & Wright,

2010:164), provide the following general guideline for interpreting the r value:

- a weak linear relationship ranges between 0.1 and 0.29;
- a moderate linear relationship ranges between 0.3 and 0.5; and
- a strong linear relationship is found in the range > 0.5.

4. Results

All the students had both NSC and CUT APS and core matriculation subject scores on record, both the students who had written the SC examination and recent school-leavers who wrote the NSC examination. Not all the students (n = 130) in the study group wrote the end of year final examinations in their first year of study, as a small group of students (n = 7; 5.4%) dropped out of the programme during the first academic year. The students (n = 30; 23.1%) who did not achieve exit level outcomes at the end of their first year of study, would repeat one or more entry level modules before they could progress to their second year of study. The distribution of academic marks for radiography students in the first year of study is shown in Table 3. Table 4 shows the correlations between the various selection tests and the students' academic marks in the various entry-level radiography modules, as well as the total average entry-level radiography mark.

When looking at the individual correlations, two main inferences can be made. Firstly, it is apparent that the various selection criteria serve better as predictors of certain individual radiography modules than others. The modules Radiographic Practice, Radiographic Pathology, and Psychodynamics of Patient Care showed moderate correlations with at least some of the selection test scores. The modules Clinical Radiographic Practice, Radiographic Image Recording, Physics, Anatomy, and Physiology, however, showed weak correlations with the selection test scores. Secondly, it is also apparent that some selection tests clearly outperformed others. Specifically, both NSC APS and CUT APS with bonus points consistently showed the strongest correlation with the eventual module mark out of all the predictors (the actual correlation coefficient, rather than the statistical significance thereof, is focused on here, as the sample sizes for the various selection tests varied considerably). While the Total CUT rating score also seemed to show moderate correlations with the module marks, it should be remembered that it is a composite score, and thus shares much with the NSC APS as one of its main components, and still it did not outperform the NSC APS. The GSAT correlations were weaker than the NSC APS correlations, but still showed some promise. By contrast, the SDS correlations were, on the whole, very weak, and the English proficiency correlations were, with two exceptions (for Radiographic Practice and Psychodynamics of Patient Care, where they were still far lower than the NSC APS correlations), also weak.

Although the individual correlations already seemed to show the relative value of the selection tests as predictors, they also showed that no single selection test as predictor can adequately account for academic performance, and they could also not reveal any duplication and redundancy amongst the various selection tests. A linear regression analysis was done to further explore the combined effect of the selection tests as predictors of academic performance. Linear regression makes it possible to identify which variable or combination of variables in this study could be considered to be the best predictors of performance. To avoid multicollinearity, the total CUT rating score was not used, as this variable already comprised some of the other variables. CUT APS with bonus marks was excluded for the same reason. Furthermore, the regression analysis used the total average mark across all modules as the criterion, as it could be expected that there would be a large degree of correlation between the various module marks, and it was felt that the average over all modules was the best predictor of overall academic performance.

Because it was felt that the relationships between predictors in the regression analysis should not be left to chance, stepwise analysis was not used, and because no explicit a-priori theoretical grounds existed for positing an ordering of predictors, a hierarchical analysis was also not preferred. Thus all predictors were entered simultaneously. The overall model was significant ($R^2 = 0.24$, $F = 5.45$, $df = 4$, $\rho = 0.0007$). The parameter estimates are shown in Table 5, and from that it is clear that the only significant predictor for academic performance was NSC APS.

One further avenue was explored in this study. Given the nature of the subjects included in the radiography course, and the generally broad selection of school subjects from which NSC APS was calculated (many of which have little bearing on the content of a radiography course), it was decided to

Table 3 – Distribution of academic marks for entry-level modules in Radiography education.

Module (number of students)	Marks (%)			Standard deviation
	Minimum	Maximum	Mean	
Radiographic Practice Theory (n = 122)	42	93	66.1	8.823
Clinical Radiographic Practice (n = 122)	47	89	70.9	9.310
Radiographic Pathology (n = 123)	35	86	59.9	12.245
Radiographic Image Recording (n = 123)	30	90	57.4	10.685
Physics (n = 123)	30	78	55.4	9.237
Anatomy (n = 123)	30	91	64.7	10.607
Physiology (n = 123)	34	84	58.2	10.306
Psychodynamics of Patient Care (n = 123)	33	90	65.2	10.613
Mean for all modules	43.1	85.8	62.2	8.614

Table 4 – Correlation coefficients of selection criteria and academic marks. (The largest effect for each module is highlighted in grey).

Entry-level module	NSC APS on matric results	CUT APS with bonus points added	GSAT	English proficiency	Total CUT rating score	SDS questionnaire
N	a = 121 b = 122	a = 81 b = 82	a = 73 b = 74	a = 73 b = 74	a = 73 b = 74	a = 73 b = 74
Radiographic Practice	[a] 0.42**	[a] 0.43**	[a] 0.42**	[a] 0.33**	[a] 0.42**	[a] 0.05
Clinical Radiographic Practice	[a] 0.26**	[a] 0.27*	[a] 0.27*	[a] 0.16	[a] 0.28*	[a] 0.01
Radiographic Pathology	[b] 0.45**	[b] 0.38**	[b] 0.27*	[b] 0.18	[b] 0.41**	[b] 0.27*
Radiographic Image Recording	[b] 0.32**	[b] 0.31**	[b] 0.23*	[b] 0.17	[b] 0.28*	[b] 0.04
Physics	[b] 0.28**	[b] 0.31**	[b] 0.23*	[b] 0.01	[b] 0.25*	[b] 0.22
Anatomy	[a] 0.28**	[a] 0.31**	[a] 0.27*	[a] 0.12	[a] 0.27*	[a] 0.14
Physiology	[b] 0.16	[b] 0.25*	[b] 0.17	[b] 0.07	[b] 0.19	[b] 0.08
Psychodynamics of Patient Care	[b] 0.48**	[b] 0.38**	[b] 0.41**	[b] 0.37**	[b] 0.46**	[b] 0.11
Total average mark	[b] 0.40**	[b] 0.39**	[b] 0.34**	[b] 0.21	[b] 0.38**	[b] 0.14

*ρ < 0.05; **ρ < 0.01.

combine SC matriculation Biology subject marks and the NSC matriculation Life Sciences subject marks as an additional predictor variable named "Life Sciences".

Table 6 shows that the more directed Life Sciences score outperformed the general NSC APS score as a predictor of every single module mark (even Clinical Radiographic Practice, where rounding would have them appear the same).

Table 7 shows that Life Sciences correlates strongly with NSC APS (which is understandable), and also that NSC APS correlates strongly with GSAT (which explains GSAT's poor performance in the regression analysis). It is interesting to note that English Proficiency correlated very strongly with GSAT, although that may just indicate that the GSAT test contains a language component.

Given Life Sciences' stronger correlations with all the Radiography module marks, it was decided to repeat the regression analysis, replacing NSC APS with Life Sciences (it was also better not to include both because of multicollinearity). The overall model was again significant ($R^2 = 0.36$, $F = 9.80$, $df = 4$, $\rho < 0.0001$), but the R^2 value was much higher, indicating better predictive fit for this model. The parameter estimates are shown in Table 8. As expected, Life Sciences remained the only significant predictor, although it still served as a stronger predictor than NSC APS.

5. Discussion

The Radiographic Practice module, the main module associated with patient positioning for diagnostic imaging, showed a moderate correlation to NSC APS and the GSAT score (see Table 4). The module Clinical Radiographic Practice, associated with clinical application of radiographic techniques, showed weak correlations with all the selection tests, particularly the SDS Questionnaire. This result was of interest because practical and technical competence was highly rated in this particular module, and skill in this module would indicate an aptitude for the chosen career of radiography. This result brought the use of the SDS Questionnaire test as aptitude and vocational personality indicator under review (Table 4). The results of the correlation for the Radiographic Pathology module, associated with pattern recognition in diagnostic imaging, showed a moderate correlation for APS, and weak correlations for the other selection test scores. The modules Radiographic Image Recording, Physics, Anatomy, and Physiology showed moderate to weak correlations to the selection tests (Table 4). The module Psychodynamics of Patient Care, associated with clinical care of the patient in a health care environment, showed a moderate correlation with most of selection tests, with the exception of the weak correlation with the SDS Questionnaire.

When considering the various selection tools used by the CUT in the selection of the students reported on in this study, several pertinent points can be made:

The results of this study show that suitability of the SDS questionnaire as part of the selection process for a career in

Table 5 – Regression analysis with NSC APS, GSAT, English Proficiency and SDS Questionnaire.

Variable	Parameter estimate	Standard error	t Value	Pr > |t|
Intercept	27.84	8.52	3.27	0.0017
APS	0.77	0.27	2.87	0.0055
GSAT	0.09	0.06	1.39	0.1677
English proficiency	−0.01	0.06	−0.2	0.8403
SDS Questionnaire	0.10	0.06	1.54	0.1284

Table 6 – Correlation coefficients of NSC APS, Life Sciences, and academic marks.

Entry-level module	NSC APS	Life sciences
N	a = 121 b = 122	
Radiographic Practice	[a] 0.42**	[a] 0.44**
Clinical Radiographic Practice	[a] 0.26**	[a] 0.26**
Radiographic Pathology	[b] 0.45**	[b] 0.50**
Radiographic Image Recording	[b] 0.32**	[b] 0.40**
Physics	[b] 0.28**	[b] 0.53**
Anatomy	[a] 0.28**	[a] 0.45**
Physiology	[b] 0.16	[b] 0.36**
Psychodynamics of Patient Care	[b] 0.48**	[b] 0.47**
Total average mark	[b] 0.40**	[b] 0.51**

*ρ < 0.05; **ρ < 0.01.

Table 7 – Intercorrelations between selection tests and Life Sciences.

N: a = 78, b = 79, c = 128	NSC APS	GSAT	English proficiency	SDS Questionnaire
Life Sciences	[c] 0.50**	[b] 0.29**	[b] 0.15	[b] 0.12
APS		[a] 0.45**	[a] 0.31**	[a] −0.03
GSAT			[b] 0.67**	[b] −0.15
English proficiency				[b] −0.20
SDS Questionnaire				

*ρ < 0.05; **ρ < 0.01.

the healthcare environment in the South African context, should be questioned. The recommendation by Cliff et al. (2007:34) that "there is a clear need to assess the outcomes of the use of multiple selection criteria on the academic progression of students thus selected" was found to be very relevant to the findings in the current study. Du Toit and De Bruin's (2002:75) reservations about the SDS questionnaire in the South African context were borne out in this study, where demographic information showed that the majority of students were not English home language speakers.

The English Proficiency test itself did not appear to have much value when predicting academic success. This may, at first, seem counter-intuitive, since one cannot, after all, master the subject if one does not understand the language. But two factors could explain this. Firstly, many of the radiographic competencies are practical skills, which can be mastered with only an adequate level of English proficiency. Secondly, the students may already have been "self-selected" as students with an adequate (if not excellent) level of English proficiency, in that simply passing school-leaving examinations and being selected for tertiary education means that their English is already at an adequate level, by and large. Although these figures are not reported in the results, it was evident that some students certainly did have very low English Proficiency scores (the minimum score was 5), but the median score was a quite high 59. This means that the analysis of English Proficiency scores could be seen as being hampered by a slight restriction of range (Sackett, Lievens, Berry, & Landers, 2007). In practical terms, this means that screening students for a minimum level of English proficiency may remain a necessary gatekeeping procedure, but that English proficiency itself may not be a good indicator of academic success.

GSAT did show some moderate correlations with the academic modules, but its high correlation with NSC APS means that it adds little information regarding academic performance not already provided by NSC APS. This was supported by its not factoring significantly at all in the regression model, as apparently its predictive variance was mostly shared with (and overshadowed by) NSC APS. In practical terms, this means that while the GSAT may be a useful test, it adds little above what is already known from NSC APS, and its usefulness is thus limited. Continued use of the GSAT might justly be classified as an unnecessary time- and financial expenditure. This finding substantiates findings by Jenkings (2004:78), where school-leaving marks were considered to have better predictive ability than the GSAT.

Table 8 – Regression analysis with Life Sciences, GSAT, English Proficiency and SDS Questionnaire.

Variable	Parameter estimate	Standard error	t Value	Pr > |t|
Intercept	21.10	7.27	2.90	0.005
Lice Sciences	0.49	0.10	4.79	<0.0001
GSAT	0.06	0.06	0.95	0.3442
English proficiency	0.03	0.05	0.47	0.6383
SDS Questionnaire	0.05	0.06	0.82	0.4154

NSC APS may also have suffered from restriction of range, since a minimum NSC APS score was needed to be admitted to the course. This may mean that the moderate correlation between NSC APS and academic performance may, in reality, be much stronger, but that it cannot be investigated adequately in this context. Nonetheless, NSC APS did factor as the only significant predictor of academic performance in the regression model. As such, it remains a valuable selection tool.

However, while NSC APS as a general measure may be useful for institutions as a tool for admitting students at large, the question remains as to whether more specific tools, designed to fit specific courses, might not be found. The use of the matriculation Biology subject marks (for SC) and Life Sciences subject marks (for NSC) as an alternative predictor to NSC APS for first-year Radiography marks provided a much stronger predictive model. It should be remembered that the Biology/Life Sciences marks do form part of the NSC APS score, but NSC APS also incorporates scores from other subjects which may have very little to do with Radiography. Focussing on scores for those school subjects which are most directly related to the tertiary study course seems, in this initial investigation, to be a promising method of selection. It was concluded that the NSC APS, according to matriculation results, and the Biology or Life Sciences subject marks, were the best predictors of academic success for the Radiography programme in the first year of study.

6. Limitations

This study did not attempt to reproduce acceptable SC and NSC scores for student selection according to Biology and Life Sciences marks, as the study sample may have been a bit too small, but it is recommended that a discriminant analysis on a larger sample might be able to provide such a suitable minimum Life Sciences score. Additionally, NSC APS may have suffered from restriction of range, since a minimum NSC APS score was needed to be admitted to the course.

7. Conclusion

This study found that certain selection criteria used during 2010–2012 for admission to the radiography programme at the CUT could predict first-year academic success, 71.5% of students were academically successful. School-leaving matriculation results, both SC for mature students and NSC results for recent school-leavers, were valid as academic

performance indicators. Other selection tests in use showed no relationship to eventual academic performance, and the use of these measures should be re-evaluated. The success rate of 71.5% for entry-level CUT radiography students in their first year of study at the CUT was commendable. The alternative selection criteria used, in particular the GSAT and the SDS Questionnaire, did not significantly contribute any additional information as performance predictors for academic success. On reflection, the recommendation is made that GSAT and the SDS Questionnaire be replaced with alternative ways to assess suitability of prospective students to the radiography programme. A more practical, discipline-specific alternative process, such as a visit to an imaging department and requesting the prospective student to reflect and motivate reasons for radiography as a career choice, should be incorporated into the selection criteria for future degree-level radiography education. What emerged from this study was that matriculation Biology subject marks (for SC) or Life Sciences subject marks (for NSC) were shown to be the strongest predictors for academic success.

It is recommended that tertiary institutions as a whole continue to use the NSC APS to select students, but that selection procedures for specific courses be allowed to add an additional requirement in terms of school courses germane to that study direction.

Significance of the work

As a professional Bachelor's degree in Radiography has been introduced in South Africa during 2014, student selection criteria should be relevant predictors to ensure academic achievement and success in the workplace.

Author contributions

C.K performed the research for the study towards a Magister in Health Professions Education; J. B. was the study leader; J.R. performed the statistical analysis and advised on the interpretation of the results; all authors were involved in the interpretation of data and writing of the manuscript.

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REFERENCES

Badat, S. (2011). University access and admissions. *Insight, 03*(6). viewed 21 October 2013, from http://www.hesa.org.za/sites/hesa.org.za/files/HESA%20Insight%20No%203_September%202011.pdf.

Botma, Y., Greeff, M., Mulaudzi, F. M., & Wright, S. C. D. (2010). *Research in health sciences*. South Africa: Heinemann.

Burdess, N. (2010). *Starting statistics: A short, clear guide*. London: Sage.

Central Queensland University (CQU). (2015). *Bachelor of medical imaging*. viewed 06 November 2015, from http://www.cqu.edu.au.

Cliff, A., & Hanslo, M. (2009). The design and use of 'alternate' assessments of academic literacy as selection mechanisms in higher education. *South African Linguistics and Applied Language Studies, 27*(4), 265–276.

Cliff, A., Ramaboa, K., & Pearce, C. (2007). The assessment of entry-level students' academic literacy: does it matter? *Ensovoort, 2*(11), 33–48.

CUL (City University London). (2013). *Radiography diagnostic imaging*. viewed 08 December 2013, from http://www.city.ac.uk/courses/undergraduate/radiography-diagnostic-imaging.

CUT (Central University of Technology). (2013a). *Prospectus 2013*. viewed 23 November 2013, from http://www.cut.ac.za/wp-content/uploads/2013/04/CUT-Prospectus-2013.pdf.

CUT (Central University of Technology). (2013b). *General admission regulations 2013*. viewed 18 October 2013, from at http://www.cut.ac.za/admission.

Derby University. (2015). *Bachelor of science in diagnostic radiography*. viewed 06 November 2015 http://www.derby.ac.uk.

Du Toit, R., & De Bruin, G. P. (2002). Structural validity of Holland's R-I-A-S-E-C model of vocational personality types for young black South African men and women. *Journal of Career Assessment, 10*(1), 62–75. viewed 01 December 2013, from http://www.ujdigispace.uj.ac.za/handle/10210/2875.

HEQSF (Higher Education Qualifications Sub-Framework), 2013, viewed 01 December 2015 https://www.ru.ac.za/media/rhodesuniversity/.../HEQSF%202013.pdf

HPCSA (Health Professions Council of South Africa). (2013a). *Bachelor of diagnostic radiography*. viewed 06 November 2013 http://www.hpcsa.co.z/.../radiography/reg_qual_bach_diag_rad_20_02_2013.

HPCSA (Health Professions Council of South Africa). (2013b). *List of tests classified as being psychological tests*. viewed 06 November 2013, from http://health.ufs.ac.za/dl/Userfiles/Documents/00001/1011_eng.pdf.

Jenkings, D. J. (2004). *The predictive validity of the General Scholastic Aptitude Test (GSAT) for first year students in information technology*. Durban: University of Zululand. unpublished mini-dissertation for a Master's Degree in Education.

Jomo Kenyatta University of Agriculture and Technology, 2015, viewed 08 November 2015, http://www.jkuat.ac.ke/departments/mls/programmes/bachelor-of-radiography/.

Mashige, K. P., Rampersad, N., & Venkatas, I. S. (2014). Do National Senior Certificate results predict first-year optometry students' academic performance at university? *South African Journal of Higher Education, 28*(2), 550–563.

Ng, C. K. C., White, P., & McKay, J. C. (2008). Establishing a method to support academic and professional competence throughout an undergraduate radiography programme. *Radiography, 2008*(14), 255e264. viewed 06 November 2015.

NQF (National Qualifications Framework). (2013). *National Qualifications Framework 2013*. viewed 06 November 2013, from http://www.nqf.org.za.

Sackett, P. R., Lievens, F., Berry, C. M., & Landers, R. N. (2007). A cautionary note on the effects of range restriction on predictor intercorrelations. *The Journal of Applied Psychology, 92*(2), 538–544. http://dx.doi.org/10.1037/0021-9010.92.2.538.