10 DISCREMINANT ANALYSIS OF GIFTED AND AVERAGE STUDENTS' PERFORMANCE IN FACULTY OF MANAGEMENT SCIENCES UNIVERSITY OF JOS

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ABSTRACT
The main objective of this study is to examine thedifferencesin performance between gifted and average students in the Faculty of Management Sciences, University of Jos. A survey research design was adopted for this study. The total population for the study was 1,122.The Participants comprised undergraduate students in the Faculty selected based on theirresults which are reflected implicitly in their CGPAs as provided checked by their level coordinators. Multivariate analysis of variance was conducted, using General Linear Models (GLM) with SPSS 21, to find out whether the (combination of) the five factors differ between gifted and average students, which was the central position of this study. The independent variables were high reasoning ability, creativity, curiosity, large vocabulary and excellent memory, while the dependent variable is gifted. The results of the evaluation of normality, linearity and multicollinearity were satisfactory. The study recommended that gifted students are significantly different from averaged students in terms of the combined and separate variables. Therefore they need to be encouraged more in identification of their giftedness skill to continue to perform better and become reasonable students that will make the Faculty proud. The study also recommends that since the characteristics were significant on the average students they need to belong to an 'elite' group to spend more extra time on studies.

Keywords: *Gifted students, Average Students, performance, Faculty of Management Sciences, General Linear Models (GLM)*

1.0 INTRODUCTION

Over a decade now, it is believed that Nigeria educational sector needs urgent attention and implementation of necessary reforms that will bring sanity, hope and total turnaround of the sector from the old ways it used to be. One of the aspects of the sector that requires urgent attention is the issue of students' academic performance admission process into higher institutions after completion of secondary school.

The Faculty of Management Sciences students are drawn from a wide range of social backgrounds and characteristics which include high reasoning ability, creativity, curiosity, large vocabulary and excellent memoryand they are primarily differentiated between gifted and average students.These attributes give them different life experiences, different educational opportunities, expectations, needs and varied academic potentials (Fraser and Killen 2003 in Nyikahadzoi, Matamande, Taderera and Mandimika, 2013). This study empirically tries to determine the performance of gifted studentsagainst theircounterparts, average students to know which is better. Access to various characteristics of individual student is found to be positively associated with academic performance in previous studies (Betts, Julian and Morell, 1998).Theidentification of gifted students remains a controversial issue in gifted education (Feldhusen&Jarwan, 2000; Hany, 1993; Heller &Feldhusen, 1986; Jarwan& Asher, 1994 cited in Pyryt, 2004).In addition to lack of agreement about the nature of giftedness, the practical issue of how to implement an identification system that combines multiple sources of information is a source of debate.In many instances operationalization of giftedness is legislated.Influential variables with averaged students had revealed that they needed more time and effort while gifted students are naturally intelligent. However, theassertion is left to be proven.

Consequently, this study intents to examine the performance of gifted students and average students'in the Faculty of Management Sciences University of Jos. The research questionsfor the study are**;** do gifted students differ from average students in Faculty of Management Sciences?Which of these characteristics (high reasoning ability, creativity, curiosity, large vocabulary andexcellent memory) primarily differentiate between gifted studentsand average students?The main objective of this study is to determine gifted and average students' performance in Faculty of Management sciences, unijos.Other specific objectives of this study are to; determine whether performance of giftedstudents differ from average student's in Faculty of Management Sciences; evaluate the characteristics (high reasoning ability, creativity, curiosity, large vocabulary, and excellent memory) between gifted students and average students in Faculty of Management Sciences.

Research Question

1. Does gifted students academic performance differ from average students in the faculty of management sciences, University of Jos?

2. Does high reasoning ability, creativity, curiosity, large vocabulary and excellent memory does not primarily differentiate between gifted students and average students?

Research Objective

1. To find out whether gifted students academic performance differ from average students in the faculty of management sciences, University of Jos.
2. To seek whether high reasoning ability, creativity, curiosity, large vocabulary and excellent memory does not primarily differentiate between gifted students and average students.

Research Hypotheses

i. Gifted students do not differ from average students in Faculty of Management Sciences, University of Jos
ii. High reasoning ability, creativity, curiosity, large vocabulary and excellent memory does not primarily differentiate between gifted students and average students.

2.0 LITERATURE REVIEW

2.1 Conceptual Review

A seminal article in the gifted education literature is Pegnato& Birch's (1959) cited in Pyryt (2004) report of the effectiveness of screening approaches in gifted education, which was based on Pegnato's (1958) dissertation.Pegnato& Birch (1959) introduced the concepts of "effectiveness" and "efficiency" of screening procedures for identifying gifted children. In the context of a school system, the effectiveness of a screening procedure is the ratio of students identified by a procedure to the total number of gifted students in the school system.Unless a school system administers the criterion measure to all of the students in the school system, the number of identified gifted students becomes the estimate for the total.

Blaženka and Dijana (2012) A two-group discriminant analysis was applied, with the first group consisting of more successful students at the Faculty of Organization and Informatics, and the second group consisting of less successful students at the Faculty of Organization and Informatics. On the basis of variables Year of enrolment at the Faculty, Current grade average and Number of exams to be passed, the students were divided into two groups: the more successful students and the less successful ones.

High intellectual ability as a consistent interaction between three basic human traits that characterize high-ability people: (a) above-average general intelligence; (b) creativity (defined as "that cluster of traits that encompasses curiosity, originality, ingenuity, and a willingness to challenge convention and tradition"; and (c) task commitment (which "represents a non-intellective cluster of traits found consistently in creative and productive individuals, including perseverance, determination, will power or positive energy") (Renzulli, 2012 cited in Fernandez, Garcia, Arias-Gundin, Vazquez and Rodriguez, 2017). The concern for the predictive ability of the linear discriminant function has obscured and even confused the fact that two sets of techniques based on the purpose of

analysis exist, i.e., predictive discriminant analysis (PDA) and descriptive discriminant analysis (DDA) (Erimafa, Iduseri, and Edokpa, 2009).

2.2 Empirical Review

Researchers have used discriminant analysis in a wide variety of settings. Ideas associated with discriminant analysis can be traced back to the 1920's through the work completed by English statistician Karl Pearson (1857 - 1936), who translated multivariate to aid in inter group discrimination (Anderson, 1996). Since then, discriminant analysis has been applied to a wide variety of discipline, for example, earlier application to financial ratio analysis to make predictions of company bankruptcy (Altman, 1968). Researchers like Deakin (1972), Johnson (1970) and Lennox (1999) also used the techniques to determine the factor responsible for a company's bankruptcy. Wong and Holt (2003) applied discriminant analysis to develop a contractor classification model that linked client evaluation aspirations with contractor potential performance in the construction industry. Sharma and Palawal (2006) used a rational linear discriminant analysis to identify linear transformation orientation that best project the feature vectors to a subspace in such a way that the overlapping between the different subspaces classes is minimum. Discriminant analysis is concerned with problem of assigning an unknown observation to a group with low error rate, therefore the basic idea of discriminant analysis is the designing of a rule or function which will determine whether group differ with regard to the mean of a variable and to usethat variable to predict group membership of new cases. The design of such a rule is called discriminant function analysis.

Jean and Judy (2016) did a research on sex determination using discriminant analysis. A large sample (370 in size) of central California prehistoric skeletal remains was analyzed for sexual dimorphism of long bones using nine femoral and nine humeral dimensions' sex of all individuals. This was assessed using traits of the Os pubis. Discriminant analysis was done separately for the robust fairly Horizon sample and the middle/late Horizon sample. Discriminant analysis was performed on all the initial predictor factors (variables) and later a combination of some of the factors. The analysis revealed that use of multiple variables did not produce appreciably better results over the use of the best variables analyzed singly. The discriminant analysis, therefore, served as a data reduction technique and succeeded in reducing the initial variables (9 in number) to only a few remaining factors being the diameter of femoral head, femoral bicondylar width and diameter of the human head (transverse or vertical). These variables produced excellent separation of the sexes with about 90% accuracy. The difference between Jean and Judy's research work and the current work are that Jeans' work focused on determination of sex (i.e. male or female) of: Prehistoric skeletal remains while the current work concentrates on determination of the performance (i.e. pass or fail) of a student in a final examination; Jean and Judy compared the discriminant function score on an individual with a standardized discriminant index to

identify the sex of the individual while this research work did not only compare the discriminant function score on an individual with a discriminant index but also compared the classification functions scores on the individual to determine the performance of an individual in examination. The similarities in the two-research works are that; The multivariate techniques used in both cases managed to reduce the initial several possible predictor variables to only a few "best" influential factors which were sufficient in giving reliable results. Both the discriminant function and the classification functions are linear combinations of the predictor variables and are both multivariate technique of discriminant analysis.

Thomas, E. W., Marr, J. M., Thomas, A., Hume, R. M. and Walker, N. (1996) did a research work on "using discriminant analysis to identify students at risk" in designing any educational intervention one often needs to determine what factors are related to success and failure in a course, identify students at risk; evaluate the impact of any new program on students' performance. Determinant analysis was used as a technique for addressing all these factors. In the research work discriminant was used to predict students' performance in an introductory electromagnetism course at Georgia Technical Institute. In this course, there was a high failure rate (greater than 30% made a grade of D or F) which resulted in a great cost to the institute and to students as success in the course was a prerequisite for all engineering majors. Discriminant analysis was used to identify the factors that were predictive of course performance and identify students who were at risk. Based on information available from the student' cumulative records, fifteen (15) possible predictor variables were initially considered and the analysis selected only three (3) of the factors predictive of course performance. The analysis could successfully predict 50% of the students who eventually failed the class.

Richard Powell, Christopher Conway and Lynda Ross all of Athabasca University (UK) carried a research work on the "Effect of students' predisposing characteristics on students' success" The question of why some students successfully study through distance education and others do not is becoming increasingly important as distance moves from a marginal to an integral role in the provision of post-secondary education. The research work first advances a multivariate framework for examining this issue. It then explores the predictive capability of students' "predisposing characteristics" about their chances of successfully completing their first Athabasca University distance education course. Using Discriminant Analysis, nine predisposing characteristics were found to be significantly related to provide the basis for a comprehensive model for understanding success and persistence in distance education.

We deal with the problem of classifying a new observation vector into one of two known multivariate normal populations. Linear discriminant analysis (LDA) is now widely available. However, for high-dimensional data classification problem, due to the small number of samples and the large number of variables, classical LDA has poor performance corresponding to the

singularity and instability of the sample covariance matrix. Recently, Xu et al. [10] suggested modified linear discriminant analysis (MLDA). This method is based on the shrink type estimator of the covariance matrix derived by Ledoit and Wolf [6]. This estimator was proposed under the asymptotic framework A0 : n ¼ OðpÞ and p ¼ OðnÞ when p ! y. In this paper, we propose a shrink type estimator under more flexible high-dimensional framework. Using this estimator, we define the new MLDA. Through the numerical simulation, the expected correct classification rate of our MLDA is larger than the ones of other discrimination methods when p > n. In addition, we consider the limiting value of the expected probability of misclassification (EPMC) under some assumptions.

This research is an extension of the work of Pyryt, (2004).Titled,"Using Discriminant Analysis to Identify Gifted Children Psychology Science.

3.0 METHODOLOGY

The survey research design was adopted for this study. The total population for this study was 1,122.Participants in this study comprised students in the Faculty of Management Sciences. The participants were undergraduate students (41% 1st year students, 37% 2nd year students, and 22% 3rd year students) of three different bachelor programs: Insurance, Banking and Finance and Marketing. Student samples of the programs included in the study were chosen by the level coordinators by selecting one or more classes in all three bachelor years to hand out the questionnaires. Student attendance in the selected classes and thus the response in the data gathering were nearly complete, as these classes were either very important or compulsory for the students. Students were selected for this study based on their prior achievements (school grades) which is reflected implicitly in their CGPA or explicitly checked by their level coordinator.

The students completed a paper and pencil questionnaire during class. The questionnaires took approximately 20 min to complete, and were semi-anonymous: the students were asked to fill in their matriculation number so that we were able to retrieve their gender, age and year of study from the level coordinators. Their names remained unknown to the researchers. Eleven students ticked multiple responses in their questionnaire and were thus removed from the study, leaving 1,109 cases from the original 1,122.

Multivariate analysis of variance was conducted, using General Linear Models (GLM) with SPSS 21, to find out whether the (combination of) the five talent factors differ between gifted and average students, which was the central question of this study. The independent variables were high reasoning ability, creativity, curiosity, large vocabulary and excellent memory. The dependent variable is gifted. The results of the evaluation of normality, linearity and multicollinearity were satisfactory. As a preliminary test for robustness, Tabachnick and Fidell (2007) suggest comparing sample variances for each dependant variable across the groups. The ratio of the largest to the smallest group variance did not approach 10:1 for any dependent variable. As a matter of fact, the largest to the smallest group ratio was about 1.9:1. The sample sizes were widely discrepant, with a ratio of 4.3:1. However, with very small differences in

variance, this discrepancy in sample sizes does not invalidate the use of multivariate analysis (Tabachnick and Fidell 2007).

In order to answer the second research question, concerning the importance of each of the fivegifted factors' unique contribution to the differences between the groups, discriminant analysis was conducted. The five variables were not independent and show significant correlations that vary between 0.17 and 0.53. Creativity, excellent memory and high reasoning ability have the highest correlations (between 0.41 and 0.53). As these variables are correlated, the univariate tests do not properly show the relative importance of the variables in distinguishing giftedstudents from average students. In order to be able to interpret the contribution of each of the variables to the differences between the two groups and to determine which of the variables discriminate most, direct discriminant analysis was used with the six gifted scales.In this study we used a significance level of 5%.

4.0 DATA ANALYSIS AND PRESENTATION

4.1 Result

The original questionnaire consisted of 35 items, divided over 5 scales: high reasoning ability, creativity, curiosity, excellent memory and large vocabulary. Based on reliability and factor analyses, items were deleted, reformulated, or replaced. The resulting questionnaire consisted of 20 items. The corrected scales were separately factor-analysed, and in all five scales, the items loaded on a single factor, showing unidimensionality of the scales (Field 2009). Using the often-used rule of thumb of 0.7 as an acceptable alpha value, and given the unidimensionality of the scales (Cortina 1993), all scales are acceptable, despite the small number of items in some of the scales.

Table 1 The five scales of the questionnaire with sample items and reliability scores

Scales	*Sample item*	*A*
High Reasoning (4 items)	*I am quick to understand things*	*0.71*
Creativity (4items)	*I am imaginative*	*0.76*
Curiosity (4 items)	*I want to learn as much as possible*	*0.70*
Excellent Memory (4 items)	*I can correctly recall all that I am taught*	*0.78*
Excellent Vocabulary (three items)	*I can use different words to explain the same thing in many ways*	*0.83*

Table 1 presents a sample item and the reliability (Cronbach's alpha) for each of the five scales.

In order to examine whether or not the items were distributed correctly over the five scales, a principal component analysis was conducted on the 20 items with oblique rotation (Oblimin). The Kaiser–Meyer–Olkin (KMO) measure verified the adequacy of the sample for analysis (KMO = 0.87).

Differences between gifted and average students.

The research hypothesis focused on determining the differences between gifted and average students with respect to the five gifted factors (high reasoning ability, creativity, curiosity, excellent memory and large vocabulary). Table 2shows the means and standard deviations.

Table 2 Descriptive statistics: means and standard deviations

Descriptive	All gifted (N = 373)		Acct gifted (N = 71)		Insurance gifted (N = 19)		Banking gifted (N = 32)		Mkt gifted (N = 242)	
	Average (N = 493)		Average (N = 187)		Average (N = 91)		Average (N = 48)		Average (N = 493)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
High Reasoning										
Average	4.8	0.8	4.8	0.7	4.8	0.8	4.9	0.9	4.8	0.8
Gifted	5.1	0.7	5.3	0.6	4.9	0.9	5.2	0.8	5.1	0.8
Creativity										
Average	4.9	0.7	4.9	0.7	4.8	0.7	5.0	0.7	4.9	0.7
Gifted	5.4	0.7	5.3	0.7	5.1	0.7	4.8	0.6	5.5	0.7
Curiosity										
Average	4.9	0.9	5.0	0.9	4.7	1.0	4.6	0.9	4.9	0.9
Gifted	5.3	0.8	5.3	0.8	5.5	0.7	4.7	0.8	5.4	0.7
Excellent memory										
Average	4.1	1.4	4.3	1.2	3.8	1.5	4.3	1.5	4.1	1.4
Gifted	4.8	1.3	5.4	0.9	5.1	1.1	4.1	1.2	4.7	1.3
Large Vocabulary										
Average	5.2	0.8	5.1	0.8	5.5	0.8	5.4	1.0	5.2	0.8
Gifted	5.8	0.7	5.6	0.8	5.5	0.8	5.8	0.6	5.8	0.7

For their large vocabulary (5.2 for Averaged and 5.8 for gifted groups), while the scores for excellent memory are lowest (4.1 for Averaged and 4.8 for gifted groups).These two characteristics also show the largest difference between gifted and averaged groups. The scores on large vocabulary show the largest standard deviations, especially for the Averaged group. Further, it is noticeable that gifted students in the banking and finance department assess themselves lower on Creativity, excellent memory, and large vocabulary than their Averaged peers do. GLM analysis using Wilks' criterion, showed that the dependent variable was significantly affected by the distinction in Gifted and Averaged groups (p= .000; partial g^2 = .04).

In order to be able to interpret the contribution of each of the variables to the differences between the two groups, direct discriminant analysis was used with the five gifted scales as predictors of membership of the gifted or averaged group. This was executed for the whole data set, as well as separately for the four departments. The discriminant function that was calculated revealed a significant

overall difference between the gifted and average students (p= 0.00, Wilk's = 0.83, $v^2(7)$ = 159, canonical R^2 = 0.17). This means that 17% of the variance can be accounted for by the combined predictors. The standardized discriminant function coefficient predictors and the discriminant function, as shown in Table 5**,** suggest that the best predictors for distinguishing gifted students from averaged students were large vocabulary, the excellent memory and creativity.

4. 2 Discussion of Findings

Table 4: Discriminant function analysis for all groups and for separate departments

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Table 4 : Discriminant function analysis for all groups and for separate departments

	Wilk's k	$v^2(7)$	P	Canonical R^2
All	0.83	159.00	0.00	0.17
Accounting	0.73	80.69	0.00	0.27
Insurance	0.79	25.03	0.00	0.21
Banking & Finance	0.78	19.01	0.01	0.23
Marketing	0.83	158.87	0.00	0,20

Table 5 : Standardized discriminant function coefficients for all groups and for separate departments

	All groups Function	Accounting Function	Insurance Function	Banking Function	Marketing Function
High Reasoning	0.05	0.29	-0.06	0.53	-0.18
Creativity	0.37	0.15	0.05	-1.01	0.62
Curiosity	0.27	0.12	0.55	-0.02	0.33
Excellent memory	0.36	0.60	0.56	-0.01	0.21
Large Vocabulary	0.41	0.18	-0.34	1.00	0.35

As shown in Table 4, separate discriminant function analyses for the four separate departments revealed significant differences between the gifted and averaged groups. The standardized discriminant function coefficients of predictors, as shown in Table 5, show that the best predictors for distinguishing gifted students from Averaged students differ for the various departments. The main predictor for accounting gifted students is their excellent vocabulary (0.60). For Insurance students, their excellent memory (0.56) and their curiosity (0.55) contribute most to the differences between gifted and averaged students. For Banking students, their large vocabulary (1.00) and creativity (-1.01) show the greatest difference between gifted and Averaged students. The main predictor for marketinggifted students was creativity (0.62).

5.0 CONCLUSION AND RECOMMENDATIONS

Conclusion

The central question of this study was whether gifted students differ from Averaged students with respect to the

gifted factors (high reasoning ability, creativity, curiosity, excellent memory and large vocabulary) that have been found to be essential for exceptional accomplishment in academic life. The results showed that gifted students are significantly different from averaged students in terms of the combined as well as the separate variables. The effect sizes were medium when measured within the separate disciplines, but small for the group as a whole. Two issues need to be taken into account here. Groups of averaged students will also include a proportion of potentialgifted students. Such potential gifted students could have various reasons for not realising they aregifted. They might not want to belong to an 'elite' group or might not want to spend extra time on studies.

A second issue to take into account is that effect size in the combined analysis has been affected by the different trends we found across departments.The second research question concerned which of the gifted characteristics contribute most powerfully to the differentiation between gifted and averaged groups. The strongest distinguishing factors for gifted and averaged students appeared to be the large vocabulary, excellent memory and creativity, while high reasoning and curiosity did not differentiate groups very much. The strong distinguishing value of creativity was unexpected, as creativity is not an explicit selection criterion for most gifted. High reasoning was the weakest factor. This was surprising, as gifted students are selected on their average school grades, and grades are affected by reasoning (Lubinski 2004). An explanation for the negligible distinguishing value of high reasoning ability could be found in the fact that average students are more likely to overestimate their ability than gifted students, whereas gifted students tend to base their judgment of their ability to succeed more accurately on the actual difficulty level. In comparison with the averaged group, these gifted students of Faculty of Management Sciences, had larger vocabulary, which concurs with Kaczvinsky's (2007) findings in a similar study in the US. Excellent memory is very dominant in the Nigerian educational culture, where students are more grade-oriented as students in for example the United States are. It is therefore not surprising that the mean scores for 'excellent memory' are higher than the scores on any of the other factors.

Recommendations

Based on findings from this study the following recommendations were offered:

i. Gifted students are significantly different from averaged students in terms of the combined as well as the separate variables. Therefore they need to be encouraged more in identification of their giftedness skill to continue to perform better and become reasonable students that will make the Faculty of Management Sciences proud.
ii. The negligible distinguishing value of high reasoning ability could be found in the fact that average students are more likely to overestimate their ability than gifted students. In this regards, the average students need to belong to an 'elite' group to spend extra time on studies.

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