Intelligence, Creativity and Gender as Predictors of Academic Achievement among Undergraduate Students

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Abstract:

The purpose of this cross – sectional study was to assess prediction of intelligence, creativity and gender on academic achievement among undergraduate students. Participants (N= 153, 105 = male & 48= female) completed intelligence and creativity tests which were compared with their cumulative grade point average (CGPA). A multiple regression analysis indicated that intelligence, creativity and gender explained 0.045 of the variance in academic achievement, which is not significant, as indicated by the F- value of 2.334. Multiple regression analyses also indicated that intelligence and creativity (gender is controlled) together explained 0.010 of the variance in academic achievement, which is also not significant, as indicated by the F- value of 1.562. Partial correlations between academic achievement and IQ, creativity scores and gender were non significant at .05. Coefficients also showed there is no significance between academic achievement and IQ and gender at .05, except for creativity (*t= 2.008, p= 0.046*). Finding shows predicting lower independent variables of this study (scores of intelligence, creativity and gender) on academic achievement (CGPA).[Journal of American Science 2009:5(3) 8-19] (ISSN: 1545-1003)

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1   Introduction

Academic achievement has been a topic of considerable interest and research for a very long time. Countless numbers of studies have been undertaken which either focused exclusively on academic achievement or investigated academic achievement in relation to other cognitive, social, and personal factors. Most of these studies have sought to determine factors that enhance academic achievement. The implications of these relationships for education are apparent since achievement in skill, concepts, and content are the acknowledged goals of the education process (Palaniappan, 2005, p36).

Unlike creativity, which has been subjected to many different definitions, academic achievement or academic ability is relatively more easily defined, measured and interpreted (Palaniappan, 2005, p36)**.** A myriad of factors have been identified as being related to academic achievement. The three fundamental of which will be addressed in this study are: intelligence (Laidra, Pullmann, & Allik, 2007), creativity and gender (Palaniappan, 2005, 2007a, 2007b)**.**
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In recent years many researches have been studies about affecting academic achievement and their correlation with other demographic and psychological factors(Aguirre Pérez, Otero Ojeda, Pliego Rivero, Ferreyra Martیnez, & Manjarrez Dolores, 2008; Boykin et al., 2005; Caprara, Barbaranelli, Steca, & Malone, 2006; Contessa, Ciardiello, & Perlman, 2005; Finn, Gerber, & Boyd-Zaharias, 2005; Gooden, Nowlin, & Frank Brown and Richard, 2006; Hong & Ho, 2005; Jeanne Horst, Finney, & Barron, 2007; Johnson,

McGue, & Iacono, 2006; Lipscomb, 2007; Magnuson, 2007; Martin, Montgomery, & Saphian, 2006; McNelis, Johnson, Huberty, & Austin, 2005; Noftle & Robins, 2007; O'Connor & Paunonen, 2007; Rimm-Kaufman, Fan, Chiu, & You, 2007; Trautwein, Lüdtke, K..ller, & Baumert, 2006; Wagerman & Funder, 2007). Accordingly, several researchers examined the relationships between academic achievement and intelligence(Al-Saleh et al., 2001; Allik & Realo, 1997; Fagan, Holland, & Wheeler, 2007; Gagné & St Père, 2002; Koke & Vernon, 2003; Laidra et al., 2007; Mayes & Calhoun, 2007a, 2007b; McGrew & Flanagan, 1997; Neisser et al., 1996; Rohde & Thompson, 2007; R. J. Sternberg et al., 2001; Watkins, Lei, & Canivez, 2007; Williams et al., 2002) as well as those on academic achievement and creativity (Cicirelli, 1965; Hirsh & Peterson, 2008a; Kobal & Musek, 2001; Struthers, Menec, Schonwetter, & Perry, 1996).

This study examines the extent to which students' intelligence is associated with their creativity and academic achievement. The aim of this research is to answer the following questions: "what are the relationships between intelligence, creativity and academic achievement?" and "what is the role of gender in academic achievement?"

1. 1 The Theoretical framework of this study

The theory applied in the present study is based on the triarchic abilities (practical, creative and analytical) measured by Sternberg's Triarchic Ability Theory (STAT). This theory explains the prediction of academic achievement, independent of general intelligence (Koke & Vernon, 2003). Sternberg, et al. (1996) reported data indicating that the triarchic abilities are related to the scores on four tests of intelligence: the Concept Mastery Test, The Watson-Glaser Critical Thinking Appraisal, the Cattell Culture-Fair test of g and a test of creative insight constructed by Sternberg and his colleagues. The highest correlations were found with the Cattell Culture-Fair test of g, which has been used extensively as a measure of general intelligence. The estimated correlations between the Cattell Culture-Fair test of general intelligence and the analytical, creative, and practical subtests of STAT are 0.68, 0.78, and 0.51, respectively (Koke & Vernon, 2003).

1.2 Past Research

In recent years, different researchers have studied the relationship between intelligence and academic achievement. Understanding the nature of the relationship between general cognitive ability and academic achievement has widespread implications for both practice and theory (Rohde & Thompson, 2007).

Watkins et al. (2007) stated that there had been considerable debate regarding the causal precedence of intelligence and academic achievement. Some researchers viewed intelligence and achievement as identical constructs. Others believed that the relationship between intelligence and achievement was reciprocal. Still others asserted that intelligence was causally related to achievement. (Laidra et al., 2007) reported that students' achievement relied most strongly on their cognitive abilities through all grade levels.

Laidra et al (2007) studied the predictors of academic achievement in a large sample of 3618 students (1746 boys and 1872 girls) in Estonia. Intelligence as measured by the Raven's Standard Progressive Matrices was found to be the best predictor of students' grade point average (GPA) in all grades. (Deary, Strand, Smith, & Fernandes, 2007) reported a strong correlation between intelligence and academic achievement. They examined psychometric intelligence at the age of 11 years old and education achievement in 25 academic subjects at the age of 16. The correlation between a latent intelligence trait and a latent trait of educational achievement was 0.81. They discovered that general intelligence contributed to success in all 25 academic subjects.

Aitken Harris (2004) examined 404 adults (203 men and 201 women), who completed four scales of a timed, group administered, intelligence test, 10 personality scales, and a creativity measures. The findings from this study suggest that achievement had small to moderate positive correlations with an

intelligence factor (which included the creativity scales).

Fodor & Carver (2000) conducted an experiment on undergraduate engineering and science students from Clarkson University, a predominantly technological university. Prior to the experiment, the students completed the Thematic Apperception Test (TAT), which was scored for achievement motivation and Power motivation. There were 144 experimental participants, 48 in each of three experimental conditions: positive, negative, or no feedback concerning prior performance on an engineering problem. Achievement motivation correlated positively with creativity score in the positive and negative-feedback conditions (r = .43 and .38, respectively) but not significantly in the no-feedback condition (r = .10). Power motivation correlated positively with creativity in the positive-feedback condition (r = .32), and negatively in the negative-feedback condition (r = −.25), but not significantly in the no-feedback condition (r = .17). Birenbaum & Nasser (2006) reported similar gender effect on achievement.

Research on gender differences on intelligence (Naderi, Abdullah & Tengku Aizan, 2008) reported no significance difference between males and females on intelligence. However, findings regarding gender differences in academic achievement are not unequivocal. Deary et al. (2007) found that there were sex differences in educational attainment. Girls performed better than boys on overall academic subjects (courses). There were also significant sex differences in all academic subject (courses) scores, except Physics. Girls performed better in every topic except in Physics. However, result shows the effect sizes of the sex differences were often substantial.

In addition, (Naderi, et. al, 2008) found there were no significant gender differences on creativity on the whole. However, the findings revealed gender differences in subscales scores. According this result females scored higher than males in the initiative factor (t = 3.566, p = .000), while males scored higher than females in the environmental sensitivity factor (t = -2.216, p = .028).

1.3 The present study

The present study examines the relative-score between academic achievement, intelligence and creativity. It attempts to provide an estimate of the

true association between academic achievement, intelligence and creativity by having fluid intelligence and creative perception inventory tests as predictors and cumulative grade point average, applied to undergraduate students. Another major issue addressed by the current study is the gender difference in academic achievement measured through the (CGPA).

2. Method and Materials

2.1 Participants
One hundred and fifty-three Iranian undergraduate students in Malaysian Universities (31.4% females and 68.6% males) were recruited as respondents in this study. Their ages ranged from 18 to 27 years old for females (mean = 22.27, sd = 2.62) and 19 to 27 years old for males (mean = 23.28 and sd = 2.43).

2.2. Instruments
2.2.1 Catell Culture Fair Intelligence Test (CFIT-33a3)

To evaluate the intelligence, every student was administered by a Scale 3 of the Catell Culture fair Intelligence Test (CFIT-3a). Roberto Colom, Botella, & Santacreu (2002) reported that this test is a well-known test on fluid intelligence (GF). Participants completed Cattell's culture fair intelligence test battery to assess individual differences in fluid intelligence.

2.2.2 Khatena-Torrance Creative Perception Inventory (KTCPI)

Creative perception was examined using KTCPI (Khatena-Torrance Creative Perception Inventory) (A. K. Palaniappan, 2005). The Khatena-Torrance Creative Perception Inventory is based upon the rationale that creative functioning is reflected in the personality characteristics of the individual, in the ways they think or the kind of thinking strategies they employ and in the products that emerge as a result of their creative strivings. The

scale presents statements to which subjects are required to respond to. The responses reflect the extent to which the subjects function in creative ways (Palaniappan, 2005).

The KTCPI consists of 50 items for some thing about my self that require yes or no answers. Scoring of responses to this measure presents little difficulty and can be done by simple frequency counts of the positive responses on the total scale. There is no time limit for the scale but most subjects complete the checklist in 10 to 20 minutes. Scoring responses to items is done by counting the number of positive responses, giving a credit of 1 for each positive response. All blank responses are scored zero (Palaniappan, 2007). However, the test was translated into Persian Language. An example of a translated item where the student is required answering ''Yes'''' or ''No'' is:

I like adding to an idea نمایم ارائه جدید نظر دارم تمایل '' or ''

The Cronbach Alpha established in the study was 0.779.

2.2.3   Cumulative Grade Point Average

For the purposes of this study, Cumulative Grade point Average (CGPA) has been used as a proxy for academic achievement. The CGPA is calculated by dividing the total amount of grade points earned by the total amount of credit hours taken.

2.3 Procedure

Every undergraduate student in the study was examined using KTCPI, CFIT-3a and CGPA. The research questions posed for the study required identifying and analyzing the distributions and regression on academic achievement. Enter linear regression analysis (with the effect size statistic R^2) was used to determine the most powerful predictors of CGPA scores using IQ, creativity scores and gender (male and female). For analysis, a probability level of .05 was chosen for statistical significance because of the large number of comparisons.

Independent and dependent variables were divided by gender, with total scores and measures calculated. The samples were selected during the

regular course time. Written and oral instructions were given for all of the participants. Participants were allowed to choose to identify themselves or to answer the tests anonymously. Students received no rewards but each was given information on the detailed result of his/her tests. Scores for measures were entered into the SPSS.

A pilot study was conducted to test KTCPI (Persian language) and the validity of the questionnaires as well as assess the suitability of the data collection procedure. The pilot study was also conducted to test CFIT-3a. As a result of the knowledge and experience gained from the pilot study, some changes were made to improve the survey instrument and to finalize a work plan for field implementation of the data collection for the actual study. Questions on the questionnaire were also revised to improve clarity and coherence.

3.   Results
3.1 Descriptive Statistics

The data was analyzed on the basis of gender, and reported in following Tables.

Table 1 shows descriptive statistics of intelligence. The finding of this result indicated that the females' mean score was not different from the males (male = 104.63, female =104.38, but standard deviation and range of the males (SD=16.35, range= 72) were greater than the females' standard deviation (14.35) and range (60).

Table1: Descriptive Statistics of Intelligence

Measure	N	Minimum	Maximum	Mean	SD	Range
Total Score	153	69	141	104.55	15.70	72
Male	105	69	141	104.63	16.35	72
Female	48	69	129	104.38	14.35	60

In Table 2, the females' mean score (33.21) was greater than the males' (31.90) for Creativity, but the standard deviations between females and males were not too much different (males = 4.36; females = 4.55). In fact, the range of scores between two groups was the same (18).

Table 2: Comparisons of Creative Perception Inventory Scores of Males and Females   (50 items)

Measure	N	Minimum	Maximum	Mean	SD	Range
Total Score	153	21	41	32.31	4.45	20
Male	105	21	39	31.90	4.36	18
Female	48	23	41	33.21	4.55	18

Table3: Descriptive Statistics of CGPA

Measure	N	Minimum	Maximum	Mean	SD	Range
Total Score	153	1.21	4.00	2.97	0.54	2.79
Male	105	2.09	4.00	3.00	0.53	1.91
Female	48	1.21	3. 73	2.89	0.56	2.52

Table 3 reveals that the females' mean (2.89) score for cumulative grade point average was lower than the males' mean score (3.00), but the standard deviations between females and males were not very different from each other (males=0.53 & females=0.56). In addition, the range scores for the females (2.52) was greater than males (1.91). However, Normal P-P Plot graphs (Expected Cumulative Probability by Observed Cumulative Probability) obtained for creativity scores are displayed in Figure 1 and 2.
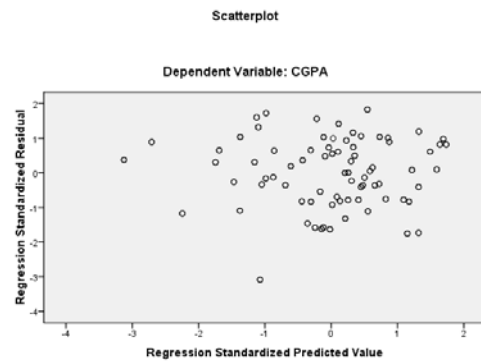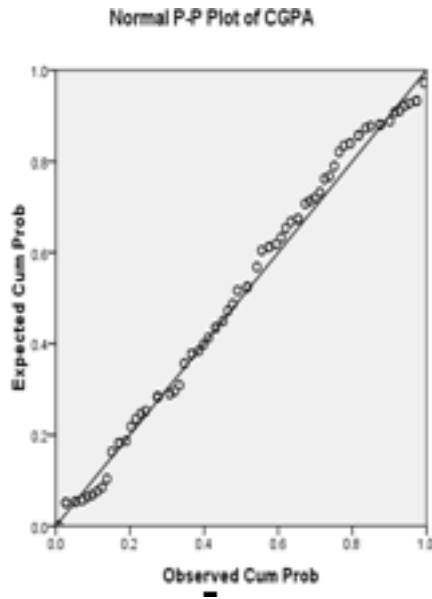
Figure.2 From the scatterplot of residuals against predicted values, we can see that there is a clear relationship between the residuals and the predicted value, consistent with the assumption of linearity.

Figure.1 Dependent variable; academic achievement (CGPA). The normal plot of regression standardized residuals for the dependent variable also indicates a relatively normal distribution.

3.2 Academic achievement predictors

The following tables show multiple regressions (standard) between CGPA and scores of the intelligence, creativity and gender. Table.4 shows variables entered. Together, gender, intelligence and creativity explain 0.045 of the variance in academic achievement (CGPA), which is not significant, as indicated by the F-value in the following tables 6 and 8.   Table10 indicates that while gender and IQ do not contribute to the variation in CGPA, creativity does explain the variation in CGPA *(t= 2.008, P= 0.046).*

Table. 5 shows when gender is controlled for, IQ and creativity explain 0.010 of the variance in academic achievement, which is not significant, as indicated by the F- values in Tables 7 and 9. This indicates that IQ and creativity do not contribute to the variation in CGPA.

3.3 Partial correlations

Partial correlations in table 11 showed that independent variables (intelligence and creativity scores and gender) was not significantly related to academic achievement (CGPA) at P < 0.05. In table 11, partial correlation also showed that intelligence and creativity scores (gender is controlled) was not significantly related to academic achievement (CGPA) at p< 0.05.

Table 4: Variables Entered Removed [b]

Mode	Variables Entered	Variables Removed	Method
1	Gender, IQ, Creativity,		Enter

    a.   All requested variables entered
    b.   Dependent Variable: CGPA

Table 5: Variables Entered Removed [b]

Mode	Variables Entered	Variables Removed	Method
1	IQ, Creativity		Enter

    a.   All requested variables (IQ , Creativity) entered
    b.   Dependent Variable: CGPA

Table 6: Model Summary [b]

Mode	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.212[a]	0.045	0.026	0.52991

    a.   Predictors : (Constant) (Creativity , IQ and Gender)
    b.   Dependent Variable: CGPA

Table 7: Model Summary [b]

Mode	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.178[a]	0.032	0.019	0.53180

    a.   Predictors : (Constant) (Creativity , IQ)
    b.   Dependent Variable: CGPA

Table 8: ANOVA [b]

Model		Sum of Squares	df	Mean Square	F	Sig
1	Regression	1.966	3	0.655	2.334	0.076 [a]
	Residual	41.840	149	0.281		
	Total	43.806	152			

    a.   Predictors: (Constant, Gender, IQ , Creativity,)
    b.   Dependent Variable: CGPA

Table 9: ANOVA [b]

	Model	Sum of Squares	df	Mean Square	F	Sig
1	Regression	1.384	2	0.692	2.448	0.090 [a]
	Residual	42.422	150	0.283		
	Total	43.806	152			

   a.   Predictors: (Constant, IQ , Creativity,)
   b.   Dependent Variable: CGPA

Table 10: Coefficients [a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.		
	B	Std.Error	Beta			Zero-order	Partial
1 (Constant)	1.811	0.448		4.40	.000		
IQ	0.003	0.003	0.82	1.015	0.312	0.101	0.083
Creativity	0.020	0.010	0.163	2.008	0.046	0.157	0.162
Gender	0.134	0.093	0.116	1.439	0.152	.095	0.117

Dependent Variable: CGPA

Table 11: Coefficients [a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.		
	B	Std.Error	Beta			Zero-order	Partial
1 (Constant)	2.092	0.405		5.160	.000		
IQ	0.003	0.003	0.85	1.046	0.297	0.101	0.085
Creativity	0.018	0.010	0.147	1.819	0.071	0.157	0.147

Dependent Variable: CGPA

4.   Discussion and Conclusion

Findings from the present study demonstrate that on the whole, the independent variables were not predictors of academic achievement. In conclusion, our findings not support the importance of IQ and gender in predicting academic achievement scores. However, it supports the role of creativity in explaining CGPA at $p< 0.05$.

Previous studies have supported the relationships between IQ / creativity and academic achievement but they did not examine the extent to which IQ, creativity and gender predict the variation in academic achievement (CGPA). The result this study in relation to IQ and academic achievement is consistent with

result obtained in previous studies (Gagné & St Père, 2002; Laidra et al., 2007; Mayes & Calhoun, 2007a, 2007b; McGrew & Flanagan, 1997; Neisser et al., 1996). In addition, the relationship found between creativity and academic achievement with studies conducted by Aitken Harris (2004), Cicirelli (1965) and Hirsh & Peterson (2008b).

The result provided some initial data supporting the use of the Cattell Fair Culture Intelligence Test and Creative Perception Inventory as self report measure of intelligence and creativity. The CGPA was also used as a measure of academic achievement. However, the result of the study did not support that the conventional measure of IQ, creativity, and academic achievement as predictive of academic achievement measured by students' CGPA. This may be due to the lack of control in the range of the CGPA scores in this specific population of high academic achievement, which was a limitation of the study. Thus, there is a need for future replication studies to use more representative samples than the present samples. Such assessment of the academic achievement with objective performance-based measures by judges such as academic achievement tests, teachers, and parents will aid to overcome some of the limitations of the study.

Future studies are also needed to determine the relative significance of creativity, IQ and gender in predicting other area of CGPA, together with academic achievement tests, written expression, reading compression, mathematics and sciences achievement.

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