Academic Performance of Engineering Students: The Role of Abilities & Learning Style

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Abstract—Abilities are important for academic success. Yet, abilities cannot be the whole story. Styles might be one source of unexplained variation. A style is a preferred way of using ones abilities. Students are thought to be incompetent not because they are lacking in abilities, but because their styles do not match the academic course chosen. The purpose of the study was to determine the role of abilities and learning styles in prediction of academic performance and their adjustment. Participants were 272 engineering students. The tools used are Myers Briggs Type Indicator, Culture Fair Intelligence Test and Student Problem Checklist. The statistical procedures employed were t-test, correlations and stepwise regressions. The analyses of the data indicated that although abilities are better predictors of academic performance, learning styles also shown a significant relationship. The study also indicates that if students learning styles matches to their chosen academic course, they tend to show better performance and less adjustment problems.

Keywords—Abilities, Academic Performance, Adjustment, Learning Styles.

I. INTRODUCTION

THE prediction of academic performance has assumed great importance in view of its practical purposes. It forms the main criteria of admission and promotion in a class. It is also important for getting a job or obtaining a degree [1]. Standardized testing and various selection tests have become crucial and continue to be at the centre of controversy in their prominence in sorting the individual for higher education. The effectiveness of testing in prediction of performance, the issues of appropriate test interpretation remain unresolved. Although psychologists agree regarding the predictive power of ability tests for various purposes, they all agree that they are imperfect predictors. According to [2] 20% of variation among students in school performance can be accounted for by differences in ability. The remaining 80% is unexplained variation. He also pointed out that it is not ability, but rather, a preferred way of using the abilities that one has, is important. The distinction between style and ability is a crucial. Ability refers to how well someone can do something. A style refers to how someone likes to do something.

As a society, we repeatedly confuse styles with ability, resulting in individual differences that are due to styles being viewed as due to abilities. In sum, we need to consider styles in the worlds of education and work. If we do not consider styles, we risk sacrificing some of our best talent to confused

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notions of what it means to be smart or a high achiever. Mismatches become particularly serious when they occur in school or work settings and that can also lead to various adjustment problems.

With this perspective the present study made an attempt to examine the role of selection and standardized tests representing the ability and a preferred way of using the abilities one has, representing the styles. This study sought to explore the impact of ability and learning styles with their professional course, namely, Engineering and also attempts to ascertain the relation to their adjustment problems.

II. REVIEW OF LITERATURE

A. Learning Styles

The term "learning style" has been defined as "the composite of characteristic cognitive, affective, and physiological practice that serve as relatively stable indicators of how a learner perceives, interacts with and responds to the learning environment" [3]. Learning styles characterize the different ways in which learner can learn effectively. Learning styles as an area of research has drawn much of the attention of the educationists and research workers.

Kolb [4] found that each field of study has its unique characteristics and that people who choose areas that are compatible with their learning styles are better in their performance. According to [5] learning problems are frequently related to the type and level of the cognitive processes required to learn the material rather than the difficulty of the subject matter. Additionally, Dunn [6] found that vivid improvement in students' achievement in cases where learning styles have been taken into account show that the way things are taught and learned had a greater impact on performance than the content covered in a course of study. Studies have shown that when learning style matches the demands of a given field of study or career specialization, higher performance results. Other studies demonstrate that learning styles are good predictors of future academic achievement and by modifying the environment, learning styles can be enhanced which results in increased academic performance. Studies by [6]-[9] demonstrated that learning styles are significantly related to academic achievement. They found that learning styles are good predictors of future academic achievement and by modifying the environment, learning styles can be enhanced which results in increased academic performance. According to [10] strategic and deep learning styles correlate positively with performance. However other studies have failed to find this probably indicates that they had too small a sample size.

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Conversely, studies by [11] found that the correlations between measures of learning style and academic performance yielded low correlations and were inadequate predictors of academic performance. Reference [12] provides tentative support for the effectiveness of a learning styles/strategies intervention. Reference [12] propounded that learning styles explained only seven percent of academic performance. In academic performance, Learning style differences were not consistently observed suggesting that some contextual variables maybe relevant. To summarize, studies correlating learning styles and field of study have found a positive as well negative relation.

B. Abilities

A myriad of factors have been identified as being related to academic achievement, the most fundamental factor of which will be considered in the present paper are intelligence, selection test rank and learning styles [7]. Many researchers agree that both ability and style should be taken into account when predicting school performance neither of them is sufficient on its own. Reference [13] postulates that most of the intelligence tests are imperfect predictors of intelligence. Usually most of these tests had not taken into consideration the other various factors like issues of personality, styles, values, interests and motivations. In this context, the comment made by [14] is very appropriate: "…the usual test of intelligence, aptitude, and achievement are proving inadequate because very often the individual tested is sought to be viewed as sufficient in him and independent from inter-individual and social factors. This neglect of the situational context in which the behaviors to be measured are embedded has made the predictions of success unreliable." The prediction of academic success or failure has been the main objective of developing intelligence tests [15]. An average correlation between IQ scores and grades is approximately 0.5 [16], varying considerably depending on the measures used. The correlation between intelligence and academic achievement appears to decline with age, showing highest in primary school and lower in middle school and college [17]. Reference [18] has also expressed doubts about the validity of such tests at higher levels. Some other studies also gives the same impressions that intelligence has been correlated with each other and with grades in school but not with other life outcomes [19]. Intelligence test scores have been found to be fairly good predictors of success at high school and comparable levels [20], [21].

However, they were also research showing that IQ tests are less predictive of success in school [22]. In developing countries, educationists must have ways of selecting a few entrants from the vast pool of aspirants to further education programs. In complex situations, it has achieved only a limited degree of success. As [23] states that there remains a critical need to probe even more deeply into the nature of intelligence and the meaning of correlation between ability tests and performance at school and at work. The concept of general intelligence may have considerable predictive usefulness whenever the situation calls for making a limited number of choices among many applicants but there are lingering conceptual limitations about its meaning. In the Indian context also, the predictability of IQ, Selection test on academic achievement is greatly debated. Most of the Indian researcher finds IQ has predictability of achievement [24], [25] whereas [26] pointed out the limitations of intelligence in predicting scholastic success in college level students. Similarly, a study by [27], on high school students' reveals that, intelligence does not vary between the high and low achievers.

Similar to IQ tests, the researchers have also given very confusing picture for selection tests as well. The usefulness of the selection tests as predictors of graduate student performance, however, has never been firmly established. In fact, formal statistical investigations (predictive validation studies) typically find that standardized tests have surprisingly little predictive content. Numerous studies of GRE's validity have been conducted with papers appearing soon after the tests were developed in the 1940s [28]. The results of research have been inconsistent and controversial although some researchers found that the GRE General and Subject Tests are valid predictors of graduate school performance (e.g. [29], [30]. Other studies showed only a small relationship between GRE scores and success in graduate school [31], [32]. Reference [32] found that the GRE was of some use in predicting graduate grades but of limited or no use in predicting other aspects of performance. Similarly the other researcher have also reported very little correlation between GRE and GMAT scores and graduate grade point averages (GPAs) in economics. Selection tests and intelligence tests may be considered as ability variables. Research on various types of selection tests like the GRE, GMAT and EAMCET was reviewed with regard to their effectiveness as predictive tools and was found to give controversial results.

C. Abilities vs. Learning Styles

A study [7] suggested that learning styles accounted for significant proportions of the variability in later achievement, although IQ was the better predictor. It would relevant and worthwhile to investigate the role of learning styles in relation to academic achievement apart from that of ability. It would also be useful to explore whether academic achievement can be predicted from learning styles.

In the absence of work done on the relative influence of ability and learning style on Indian students, there is a need felt for doing work in this area. More recent studies in the West have demonstrated the effect of these two factors plus other non-cognitive factors such as study habits, adjustment, etc. in successful academic endeavors.

Although the selection, ability and cognitive tests are seen as strong predictors but for different reasons, they are also seen as imperfect predictors too. Similarly the Sternberg postulates that in the assessment tests, variance of 20% was due to the differences in ability but variance of 80% is due to inexplicable disparity [32].

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D. Adjustment

For the most part, the literature review reveals a negative relationship between adjustment and academic achievement [33]-[35].

With this perspective in view the present study made an attempt to examine the role of selection and standardized tests representing the ability and a preferred way of using the abilities one has, representing the learning styles. This study sought to explore the impact of learning styles and ability in a professional course, namely, Engineering and also examine the relationship of adjustment.

E. Hypothesis

❖ There would be significant differences between ability variables like Selection test (EAMCET) rank and mental ability and adjustment problems between Sensing-Thinking and Intuitive–feeling learning styles.
❖ There would be significant relationship between students of learning styles and their abilities variables (CFIT, EAMCET rank and academic performance) and adjustment problems to academic performance.
❖ There would be a significant impact of ability variables as measured by selection test (EAMCET), mental ability (CFIT) and learning styles and adjustment problems to academic performance.

III. METHOD

A. Research Design

Depending on the nature and purpose of the study, professional students of the engineering college students were selected and required data was collected from them. As such, the study may be considered expost-facto field study. The criterion variable is academic performance and predictive variable is abilities, (IQ, Selection test) and Learning styles (Sensing–Thinking Types and Feeling–Intuitive Types) and adjustment problem.

B. Participant

A total of 272 students in the third year engineering course are taken. Out of 272 students, 73 were from the university engineering college and 199 students from a private engineering college. The criteria for sample selection used were students from all branches of engineering studying the third year of engineering were taken. Third year were selected to avoid dropouts and to get academic performance for at least two years. It was also felt that such a time specification would enable the investigator to obtain a more reliable estimate of the academic performance of the students in the first two years of their study. The criterion for sample selection was random sampling.

C. Variables

The dependent variables of this study are academic performance and independent variables are Abilities, Styles, and Adjustment problems. The ability variables are entrance, Selection exam (Engineering, Agriculture and Medical Common Entrance Exam (EAMCET) scores, mean=10071.79, SD=9955.63), academic performance (aggregate percentage of marks of 1st and 2nd years of engineering course, mean=67%, SD=7.84) and Scores on CFIT (Mental ability, mean=23.76, SD=4.51) and styles variable is learning styles (MBTI), Thinking-Sensing Styles(T-S) students (81%), Feeling-Intuitive Styles (F-I) (19%) and adjustment problems are academic problems (M=4.8, SD=2.13) social problems (M=2.53, SD=1.65) and family problems (M=2.70, SD=1.88) and total problem (M=10.12, SD=3.99).

D. Measures

1. Assessment of Ability

In this study, Culture Fair Intelligence Test (CFIT) -Scale 3 is preferred [36]. Since the CFIT Scale 3 takes a shorter time to administer and measure fluid intelligence, it was preferred over the Raven's Progressive Matrices. The reliability of the test has been evaluated both in terms of dependability coefficient (0.84 to 0.94) and the homogeneity coefficient (0.82 to 0.95).

2. Assessment of Learning Style

In this study Myers-Briggs Type Indicator was used as it is widely used [37]. The Myers-Briggs Type Indicator is a self-report questionnaire designed to make Jung's theory of psychological types. In the present study Form G has been used. The Form G consists of 126 items. It takes about 30-40 minutes to complete the test. The MBTI instrument identifies four separate dichotomies: Extroversion versus Introversion, Sensing vs. Intuition, Thinking vs. Feeling, and Judging vs. Perceiving. These types can also be compressed into the following two types based on traits: Sensing-Thinking (ESFP, ESTP, ISTJ, ISFJ, ESTJ, ENTJ, ISTP, INTP) and Intuition-Feeling (ENTP, ENFP, INTJ, INFJ, ESFJ, ENFJ, ISFP, INFP).The internal consistency of the four MBTI scales is high in all samples available to date, whether computed using logical split-half, ranging from 0.82 to 0.92 consecutive item split-half, or coefficient alpha.

3. Assessment of Student Problems

Student Problem checklist is prepared by the researcher. This checklist is developed on the basis of the problems observed in the engineering students. The main reason for developing this checklist was because of not finding a suitable scale.

E. Procedure

As mentioned earlier, the sample was selected from the university Engineering College, as a public educational institution and Private College of Engineering. All the assessment tools were administered on two separate days in each of the colleges. The subjects were tested in a conducive environment, with suitable breaks in between. Standard instructions for each scale were given accordingly.

F. Data Analysis

In addition to the descriptive statistics such as frequency, percentage, mean and standard deviation, the inferential statistics like 't' test are carried out to identify the significant between low and high academic performer and also between

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thinking–sensing and intuitive–feeling learning styles. And also to identify the variables that predict academic achievement of engineering students, separate stepwise regression analyses were performed.

IV. FINDINGS

Results found out using various statistical measures. The study examines the role of learning styles and abilities to academic performance.

A. Ability and Adjustment Problem in Relation to Learning Style

Firstly the study attempts to explore the ability and adjustment among T-S and F-I learning styles. In support to

Hypothesis no.1, it was found that the mean of selection test scores of Sensing- Thinking (9,368) and Feeling-Intuitive (12,927) styles. The difference is significant at the 5% level.

As shown in the Table I, participants mean of academic performance in terms of their learning styles were M=65 for Intuitive-Feeling types and M=68 for Thinking-Sensing types. This finding suggests that S-T subjects are better academic performers (t=2.16, p<0.01 level) and have better selection test ranks (t=2.31, p<0.01) than the F-I group. However both these learning groups are not significantly different with respect to mental ability (t=.04, p>.05). People who choose areas that are compatible with their learning styles are better in their performance. This suggests that T-S types are suitable for engineering course.

TABLE I
LEARNING STYLES AND THEIR ABILITY AND ADJUSTMENT PROBLEMS

Variables	Sensing-Thinking Styles (S-T) (n = 220)		Feeling-Intuitive Styles (F-I) (n = 52)		t-value
	Mean	SD	Mean	SD	
EAMCET Scores	9,368	8,791	12,928	13,465	2.31*
Marks Percentage	67.53	7.6	64.94	8.52	2.16*
Mental Ability (CFIT)	23.82	4.34	23.54	5.23	0.4
Adjustment Problems	Mean	SD	Mean	SD	
Academic Problems	4.84	2.11	5.02	2.21	0.54
Social Problems	2.44	1.62	2.94	1.74	1.98*
Family Problems	2.61	1.85	3.12	1.96	1.74
Total Problems	9.9	3.98	11.08	3.96	1.92†

*p < .05 † p < .10 marginally significant

With regard to social problems, it is observed that the Feeling-Intuitive styles students manifest more social problems than the Sensing-Thinking styles of group, which is significant (t=1.98, p<.01). In the case of total problems marginal significance is observed. The F-I styles students manifest more problems than the S-T types. In the case of academic and family problems no significant differences were observed between the two learning style groups. On the whole the Feeling-Intuitive types manifest more problems than the Sensing-Thinking styles of students.

B. Predicting Academic Performance:

The academic performance of the students was measured taking into account marks obtained by them in the first 2 years of their course. It is to be examined as to what factors influence the performance of the student. The relation of

marks with the ability variables, learning styles and adjustment problems was examined and the results are present.

The intercorrelation matrix (Table II) suggests that students who are the Thinking-Sensing types tend to show improved academic performance. It is been observed academic performance is inversely correlated to academic problem (r=0.22, p<.01) and family problem (r=0.20, p<.01) denotes that less academic and family problems results in high academic performance whereas EAMCET scores show significant relation with family problem. It also shows that students having low IQ will also manifest social and family problems. These findings suggest that students who do well academically have better selection test scores. They also have significantly less academic problem, family problems, and total problems. Learning styles show a small but significant relationship to academic performance (r=013, p<.05) and rank (r=0.14, p<.05).

TABLE II
INTERCORRELATIONS MATRIX OF LEARNING STYLES AND ADJUSTMENT

Variables	CFIT score	EAMCET Scores	Learning Styles	Academic Problems	Social Problems	Family Problems	Total Problems
Marks Percentage	0.40**	-0.54**	0.13*	-0.22**	-0.04	-0.20**	-0.23**
CFIT		-0.30**	0.02	-0.03	-0.19**	-0.14*	-0.16**
EAMCET Rank			-0.14*	-0.01	0.01	0.17**	0.07
Learning styles				-0.03	-0.12*	-0.11	-0.12
Academic Problems					0.21**	0.18**	0.70**
Social Problems						0.36**	0.70**
Family Problems							0.72**

* p< .05. **p < .01

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Combination of these variables would regress on academic performance. Hence a regression analysis was done. The regression analysis was done with academic performance as the dependent variable and the learning styles, ability variables, and adjustment problems as the independent variables

TABLE III
COEFFICIENTS OF STANDARDIZED REGRESSION ON ACADEMIC PERFORMANCE

Variables	Unstandardized Coefficients	Standardized Coefficients	t-value
CFIT	0.15	0.27	5.17**
EAMCET Score	0.00	0.46	- 8.80**
Learning styles	-0.34	0.22	- 0.45
Academic Problems	-7.71	-2.11	-1.23
Social Problems	-6.40	-1.35	-1.02
Family Problems	-7.19	-1.71	-1.15
Total Problems	6.91	3.55	1.17

*$p < .05$. **$p < .01$*

A significant multiple correlation of .642 was obtained (F=25.12**) which accounted for 41 percent of the variance in academic performance. The standardized beta coefficients for the regression of academic performance are presented in Table III.

The table indicates that the variables of selection test EAMCET score, CFIT raw score, explain the variance in academic performance to a significant level. Students with a lower rank on the selection test, a higher mental ability score, tend to display a marked academic performance. Learning styles and adjustment problems do not seem to significantly influence academic performance directly though indirectly they may have an effect on academic performance. The results of the present study highlight the importance of the rank in the selection test (EAMCET) being administered to students seeking admission into Engineering colleges. The rank obtained by a student on this test significantly influences the academic performance in subsequent courses. The rank seems to be a function of the learning style adopted. CFIT or the indicator of mental ability has a significant relation with the rank on the selection test. These findings stress the importance of a good rank in the selection test as it ensures admission into a desired course and also determines performance in subsequent courses. The results also indirectly stress upon the importance of learning styles. Learning styles significantly determine the academic performance of students. Learning styles are significantly related to the academic and social problems experienced by students. Students with a lower rank on the EAMCET, a high mental ability score tend to have a good academic performance. Learning styles and adjustment problems do not seem to significantly influence academic performance directly. The remaining 59% most likely, is contributed by variables that were not included in this study.

The stepwise regression also used to find out the predictors of academic performance, the first step, rank (F=106.6) accounted for 29% of variance and rank and IQ (F=70.24) accounted for 35% of variance and thirdly rank, IQ and academic problem (F=56.17) has accounted for 39% of variance in academic performance. The rank, IQ and academic problem show significant impact on academic performance (β=0.466, p<0.01), (β=-0.25, p<0.01) and (β=-0.209, p<0.01). However 61% percent factors contributing to academic performance are unknown.

V. DISCUSSION AND CONCLUSION

The objective of this study was to examine the relation between academic performance, rank in the selection test, intelligence, learning styles, and adjustment. The combination of S-T types and F-I types of students are taken into consideration, differences are observed in their selection test ranks and academic test performance. The F-I types of students show low performance in selection and academic examination, but the mental ability is the same for both the group of students. As [38] stated, "we repeatedly confuse styles with abilities, resulting in individual differences that are really due to styles being viewed due to abilities." The tests suggests the F-I types demonstrate lower performance in the selection and class exams while T-S types show higher performance among engineering students which is partially supported by [39] findings that each field of study has its unique characteristics and that people who choose areas that are compatible with their learning styles are better in their performance. Henceforth, T-S whose choose compatible course shows better performance.

In congruence with the findings of the present study, [40] using Kolb's Learning Styles Inventory (LSI) found a great diversity in the learning styles of the students. He concluded that divergers and assimilators have a great difficulty academically than the convergers and accommodators which are equivalent to Feeling-Intuitive and Thinking-Sensing and according to reviewers [41], [42], convergers are best at finding practical uses for ideas and theories and usually do well on conventional tests.

With regard to adjustment, the S-T and F-I groups had no differences, on academic and family problems while there are differences on social problems with the F-I group having more social problems than the S-T group. Overall, the F-I group has more total problems though it was not significantly different from that of S-T groups. These results when viewed in the light of [41], [42] had confirmed the findings that Sensing-Thinking types which are equivalent to accommodation and convergence dimension do better academically and are likely to have less problems than the divergence- assimilation which are equivalent to Feeling-Intuitive type. As [38] stated that the people whose learning styles/thinking styles do not match the expectations are derogated for all wrong reasons. What is seen, as intransigence may actually be nothing more than a mismatch between the learning styles. From the analysis it is also become evident that mental ability remains the same for both T-S and F-I groups. This suggests which reflects that it is not the ability but the styles and matching of learning styles with ability that actually plays a crucial role in performing well in the exams.

The intercorrelation matrix suggests that students who are the Thinking-Sensing types tend to show improved academic

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performance. The findings suggest that students who do well academically have better selection test score. They also have significantly less academic problem, family problems, and total problems. Learning styles show a small but significant relationship to academic performance. The results suggests that various variables such as personality factor that influence cognitive styles, and approach to different components of intelligence that are not measured by conventional tests of intelligence, which give a general IQ factor. Components such as creativity, practicality, analytical as stated by [37] about Triarchic Theory of intelligence and context specific potentials as stated by [23], bio-ecological theory of intelligence may be more relevant.

The regressions suggest that the selection test scores, IQ obtained by a student significantly influences the academic performance in engineering course. The selection test scores and academic problem shows inverse impact, which implies that the lower the score the better the performance, the lower the score in academic problem, having less academic problem demonstration good academic performance. The selection score is related to learning style adopted. Learning styles show a small but significant relationship to academic performance. Those who get good scores in EAMCET and have good mental ability but do not have a suitable learning style (like the F-I type), seem to experience greater academic anxiety and lower performance.

The findings of the study, lead to the conclusion that learning styles and the abilities of the student, determine the likelihood of obtaining a good rank in a selection test and performing well in subsequently admitted courses. Students preparing for entrance tests for admission into various courses would benefit more if they assess the appropriateness of their learning style to the demands of the test and the course. Learning styles could also be used to predict what kind of instructional strategies or methods would be most effective for a given individual and learning task [43]. Everyone has a distinct learning style and it is dependent on many personal factors. However, with proper guidance, an individual can be taught to adopt an appropriate leaning style. However the present study uncovers 59% of other factors contributing to academic performance. Further studies such as a more comprehensive study including other variables (family background, quality of teaching etc.) in addition to the present ones may be taken up for a better prediction of academic performance. Studies can be conducted to examine the role of ability and learning styles of students preparing for entrance examination and relate them to the ranks obtained.

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