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# Predictability of engineering students' performance at the University of Engineering and Technology, Peshawar from admission test conducted by educational testing and evaluation agency (ETEA), NWFP, Pakistan

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## Abstract

**Introduction:** Educational Testing and Evaluation Agency (ETEA), NWFP since from its inception (1998) has conducted eight sets of Entrance Test, for the NWFP University of Engineering and Technology (UET) and Medical Colleges of the province. However, no research studies have been conducted to validate these tests in term of predicting future performance of the students. The main purpose of this study is to examine the Predictability of Engineering students' performance at the University of Engineering and Technology, Peshawar from admission test conducted by Educational Testing and Evaluation Agency (ETEA), NWFP.

**Method:** A cohort of 203 engineering students, who were admitted for the four-year programme in different disciplines at University of Engineering and Technology (UET), Peshawar, NWFP in the 2000-2001 academic session, were considered. The association between the **predictors** (FSc, Entry test scores and overall merit) and the **criterion** (academic achievements/scores of engineering students from first to final year) were analyzed using appropriate statistical procedures on SPSS-10.

**Result:** The data show significant relationship between FSc marks and students scores up to third year at the 0.05 level while relationship between entry test marks and overall merit with students scores up to third year show significant relationship both at the 0.05 and 0.01 level for male and overall students. But for the female students and some engineering disciplines, the result is even more surprising as it shows that there is a negative relationship between the predictor's scores and the academic achievement. This is because analyses were based on comparatively smaller sample sizes of students (female were 7% of the total students only). The relationship between Predictors (FSc, Entry test and Overall merit) and final year scores was found negative for male and overall students but it was found significant for female students.

**Conclusions and suggestions:** Overall, our findings indicate that there is significant relationship between the Predictors (FSc, ETEA entry test scores and overall merit) and the academic achievement of engineering students. However, development of additional predictors, such as interview or test of non-cognitive domains of the students may improve the accuracy of admission decisions.

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*Keywords:* Predictive validity; engineering admission test; Educational Testing and Evaluation Agency (ETEA) and students' scores.

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## 1. Introduction

“Any measures that is commonly used for selection has effects throughout the educational system, both direct and indirect. There is, therefore, a need to validate or justify that use” (Willingham, Lewis, Morgan, & Ramist, 1990). Such issues come under the domain of predictive validity. “Predictive validity is the degree to which a test can predict how well an individual will do in a future situation. Predictive validity is extremely important for test that one used to classify or select individuals. The predictive validity of a test is determined by establishing the relationship between scores on the test and some measure of success in the situation of interest. The test use to predict success, is referred to as the **Predictor**, and the behaviour predicted is referred to as the **Criterion**” (Gay, L.R. 2000).

Nearly all colleges and universities in the U.S. require that applicants take at least one major standardized test prior to admission. The SAT for undergraduates and the Graduate Record Examination (GRE) for graduate students are among the most widely used standardized tests by a large number of colleges. Scores on these tests are most often used to predict students' future achievement in a department's curriculum (Lydia, S. 2005).

In Pakistan, conventionally the scores of intermediate examinations were used to develop a merit list and top students were admitted based in the number of seats in the college/university (Baig, A.L. et al, 2001).

Pakistan Engineering Council (PEC) was established as a body corporate under an Act of the Parliament on January 10, 1976 for the regulation of engineering profession and education in Pakistan. Pakistan Engineering Council Regulations for Engineering Education (1985) in Pakistan clearly declared the entry test for admission to engineering institutions/universities in these words “A candidate seeking admission in an Engineering Institution/University for working towards Bachelor's Degree in any recognized branch of Engineering must passed an **entrance test** conducted by the respective Institution or University” (PEC, 1985). But it could not materialize this obligation of entrance test for admission to engineering institutions at that time.

Till the year 1999, the students of public sector colleges were selected on the basis of intermediate exams. Agha Khan University (AKU) started admitting students on the basis of a written admission tests and interview both conducted in-house. The other private sector universities viz Baqai and Ziauddin also adopted the similar selection procedure (Baig, A.L. et al, 2001).

In November 1998, Educational Testing and Evaluation Agency (ETEA) NWFP, was established by the Government of NWFP. It is supervised by a Board of Governors, headed by the Chief Minister, NWFP. Initially, the ETEA was established to undertake administration of Entrance Tests for admission to Engineering and Medical institutions of the province (ETEA, 2005).

It is clear from these facts that in Pakistan we have been adopted entry test from mid-ninety while at global level the Scholastic Aptitude Test (SAT), which was introduced by the College Board with the goal of standardizing the admissions process to universities and colleges in the United States in 1926 (Angus, S. M. et al 2000).

In the history of predictive validity, two studies are considered as mile stone in this area, which covered of almost  $\frac{3}{4}$  period of a (twentieth) century. These studies were conducted by of the Wilson (1983) and Burton, N.W. and Ramist, L. (2001).

The study of Wilson (1983) covers classes graduating between 1930 and 1980. His study was based of about 12,000 students who graduated from 40 institutions. The main purpose of his study was to determine predicting cumulative college GPAs admission variable like SAT. The study found that the combination of SAT scores and high school records provided better predictions than either grades or test scores alone and SAT scores made a substantial contribution to predicting cumulative GPAs

Willingham (1985) evaluated more than 30 factors, as predictors of college grades to in order determine which would best predict college grades/outcomes. He found that only six of the factors were significant correlated with student academic achievement in college. He concluded that the high school GPA of the student was the strongest predictor of college grades. The studies also identified that standardized test scores were the second best predictor of future performance/college grades (Willingham, 1985; Willingham et al., 1990).

Ramist et al. (1994) after examining students in 11 different colleges, found that the combination of SAT score and high school GPA was significantly correlated ( $r = 0.420$ ) with freshmen grades. Henrysson et al. (1985) have conducted research on 200 students in the Mechanical engineering programme and 400 in the Electrical engineering programme. They found the correlation between GPA and the number of scores awarded on courses in the technical programmes was about 0.40, but the correlation with the mean of the grades in mathematics, physics and chemistry

from upper secondary school was somewhat stronger than 0.40. This study was conducted on predictive validity of traditional criteria of selection not on SweSAT for higher technical studies.

Lovegreen, T.A. (2003) study was focused on predicting the academic success of female engineering students during the first year of college using the SAT and non-cognitive variables (measured through Non Cognitive Questionnaire, NCQ) as preadmission variables. This result of Lovegreen, T.A. (2003) was contradictory to the previous research, which stated that using non-cognitive variables, and specifically the NCQ, predict the academic success.

Karakaya, I., & Tavşancıl, E. (2008) investigated the predictive validity of the 2003 University Student Selection Examination (ÖSS) in Turkey. Raw scores, standard scores, and placement scores (YEP) were preadmission variables while freshman grade point average (FGPA) in higher education was considered as criterion in this study. The study was based on the analysis of 2103 students from six programmes i.e. agricultural engineering, civil engineering, law, business administration, social studies education, Turkish Language and Literature. Using Stepwise regression analysis, the study found that the significant predictors of students' freshman grade point average (FGPA) was placement scores (YEP) which is used for the placement of agricultural engineering, civil engineering, and social studies education program students.

### *1.1. Predictive Validity studies Research in Pakistan*

The ever first study conducted in Pakistan on predictive validity of admission criteria was of Klitgaard, R. E. et al (1978). The main focus of their study was to determine whether measures of intellectual merit (intermediate examination score) that are used as criteria for admission to the University of Karachi in Pakistan have predictive validity. The merit of Intermediate examination scores (12 year schooling) was considered as admission criteria/predictors for the students' final marks of graduation of the pharmacy, medicine, and engineering schools. Using Regression analyses, the researchers found that the current criterion of admission (based on intermediate score only) has weak predictive power for the student's subsequent university performance. Even the researchers included matriculate test scores and several independent variables in the analysis, but even then they found little predictive power of the admission criteria/variables.

In Pakistan a few studies have been conducted on the predictive validity of Entry Tests, but mostly on medical entrance tests. The results of the reported studies are also not conforming to the international studies, which pose a question mark for the usefulness of these entry tests. For example one of the studies conducted by Baig, L. A. et al (2001) to determine the predictive validity of Entry Test for Karachi Medical and Dental College conducted by Institution of Business Administration (IBA), concluded that the correlation coefficient  $r$  was 0.057 for MBBS Students, which was not significant ( $P=0.544$ ) and  $-0.172$  for BDS Students of Karachi Medical and Dental College (KM & DC), that was also not significant ( $P=0.364$ ). The findings of this study show that there was no significant positive relationship between IBA Entry Test Scores and academic achievement of MBBS students. For the BDS students, there was a negative relationship between the IBA scores and the academic achievement. So the researchers suggested re-structuring /improvement of the entry test on the basis of their study.

Baig, L. A (2001 Sep) conducted a similar study over the students of the **first** four batches of Karachi Medical & Dental College (KMDC), graduated in 1997, 1998, 1999 and 2000. The main purpose of the study was to assess the predictive validity of the medical college admission criteria i.e. Secondary School Certificate (SSC), Higher Secondary Certificate (HSC) and Institution of Business Administration (IBA) admission test, for academic performance of MBBS students at KMDC. After using correlation and step-wise linear regression analysis for the results of total of 166 students, the researcher concluded that the IBA admission scores, combined with Higher Secondary Certificate (HSC) marks could predict academic achievement of medical students for the first three to four years, while the academic performance of students at Higher Secondary Certificate (HSC) had no effect on the academic performance of medical students. The study, however does not predict the performance for the final year, which needs practical and clinical competencies on the part of medical graduates.

Another study, on the predictability of admission criteria, involved 3 batches of Ziauddin Medical University (at Karachi in Pakistan) students who graduated between 1995 and 1997 was conducted by Huda N, Dosa TI, Alam E, Agha S. (2001 Nov). A total of 159 MBBS student records were analyzed. The Researchers concluded that none of the component of admission criteria i.e. Secondary School Certificate (SSC), Higher Secondary Certificate (HSC),

Ziauddin Medical University(ZMU) admission test and interview scores predict the academic achievement of medical students in the professional examination.

## 2. Methodology

Subjects for this study included 203 engineering students, who were admitted for the four-year programme in different disciplines at University of Engineering and Technology (UET), Peshawar, NWFP in the academic session 2000-2001. The final sample of 203 students was made up of 74 Electrical, 43 Mechanical, 60 civil, 6 Agriculture, 15 Chemical and 5 Mining Engineering students.

The instrument used in this study was the Entry Test for admission to University of Engineering and Technology, Peshawar, prepared by Educational Testing and Evaluation Agency( ETEA) NWFP. The Test composed of Multiple- Choice Items. These questions based on three subjects: Physics chemistry, Mathematic (60 Questions from each subject), and English (20 Questions). (Source: ETEA Students Guide for Entry test (PP.1-3).

The criterion measure in this study was the academic achievements/scores of engineering students from first to final year, while Predictor set include: Entry Test scores, F.Sc scores and the overall merit (the combination of Entry Test and F.Sc scores.).The data collected through various means were entered on SPSS-16 for utilization of the Means, standard deviations and “correlation techniques for analysis:

## 3. Results

Table-1 and 2 indicate Mean, Standard Deviation, and range (minima-maxima) of the engineering students (admitted in 2001 academic session) for each of the predictors and Criterion (students scores) for the combined gender and separately for men and women respectively. It is clear from the data(mean of female=845 and male =812) that marks of female students were higher than male students at FSc level while on entry test they have shown approximately equal performance. This why the overall merit of female students was high (average=691.1583) than male students (673.5012) for admission. However, no significant difference was found between the scores of male and female students.

Table -1: Sample size, Minimum, Maximum, Mean and Standard Deviation of the Predictors and Criterion of the overall Engineering Students (Gender combined)

| Variables            | N   | Minimum | Maximum | Mean     | Std. Deviation |
|----------------------|-----|---------|---------|----------|----------------|
| SSC                  | 203 | 459.00  | 751.00  | 653.8030 | 48.3399        |
| FSC                  | 203 | 667.00  | 921.00  | 812.3498 | 43.8698        |
| ENTRYTEST            | 203 | 322.00  | 568.00  | 453.8522 | 55.1236        |
| MERIT                | 203 | 543.45  | 799.73  | 674.0263 | 40.2586        |
| 1 <sup>st</sup> Year | 185 | 587.00  | 949.00  | 757.4703 | 69.9662        |
| 2 <sup>nd</sup> Year | 190 | 696.00  | 1131.00 | 913.0158 | 89.1639        |
| 3 <sup>rd</sup> Year | 195 | 649.00  | 1030.00 | 863.5385 | 80.1098        |
| Final Year           | 215 | 750.00  | 1215.00 | 972.3209 | 89.2565        |

Table-3 shows Correlation between Predictors (FSC, entry test and overall merit) and the First, Second, Third and Final year scores for overall sample and for male and female of Engineering Students separately. The data show significant relationship between FSc marks and students scores up to third year at the 0.05 level while relationship between entry test marks and overall merit with students scores up to third year show significant relationship both at the 0.05 and 0.01 level for male and overall students. The case of female students was found different because their FSc marks and entry test result shows no significant relationship with students scores while their overall merit indicates significant relationship to some extent.

The position of Final (Fourth) year is quite different from First, Second and Third year. The relationship between Predictors (FSc, Entry test and Overall merit) and final year scores was found negative for male and overall students but it was found significant for female students.

Table- 2: Sample size, Minimum, Maximum, Mean and Standard Deviation of the Predictors and Criterion of the overall students (Gender wise)

| Variables   | Minimum |        | Maximum |         | Mean     |          | Std. Deviation |         |
|-------------|---------|--------|---------|---------|----------|----------|----------------|---------|
|             | Male    | Female | Male    | Female  | Male     | Female   | Male           | Female  |
| F Sc        | 667.00  | 780.00 | 905.00  | 905.00  | 812.0838 | 845.4000 | 43.5594        | 38.1946 |
| ENTRYTEST   | 325.00  | 372.00 | 568.00  | 538.00  | 452.4469 | 451.3333 | 53.3958        | 46.3460 |
| MERIT       | 543.45  | 634.84 | 799.73  | 734.66  | 673.5012 | 691.1583 | 39.7178        | 35.4024 |
| First Year  | 587.00  | 587.00 | 949.00  | 869.00  | 754.3067 | 755.7143 | 66.8008        | 78.5596 |
| Second year | 696.00  | 808.00 | 1099.00 | 1083.00 | 909.3902 | 941.4615 | 86.8688        | 91.0061 |
| Third Year  | 649.00  | 749.00 | 1028.00 | 1003.00 | 860.4737 | 867.8462 | 80.7718        | 74.9520 |
| Final Year  | 750.00  | 800.00 | 1215.00 | 1042.00 | 970.9725 | 950.3846 | 87.8534        | 73.6224 |

All tables should be numbered with Arabic numerals. Headings should be placed above tables, underlined and centred. Leave one line space between the heading and the table. Only horizontal lines should be used within a table, to distinguish the column headings from the body of the table. Tables must be embedded into the text and not supplied separately. All tables should be numbered with Arabic numerals. Headings should be placed above tables, underlined and centred.

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Table-3 Correlation between Predictors and the First, Second, Third and Final year scores of Engineering Students

| Variables   | F Sc   |        |         | ENTRYTEST |        |         | MERIT   |        |         |
|-------------|--------|--------|---------|-----------|--------|---------|---------|--------|---------|
|             | Male   | Female | Overall | Male      | Female | Overall | Male    | Female | Overall |
| First Year  | 0.187* | 0.291  | 0.201*  | 0.345**   | 0.465  | 0.400** | 0.339** | 0.473  | 0.383** |
| Second year | 0.193* | 0.322  | 0.228** | 0.288**   | 0.601* | 0.324** | 0.241** | 0.590* | 0.295** |
| Third Year  | 0.179* | 0.112  | 0.173*  | 0.280**   | 0.250  | 0.304** | 0.233** | 0.240  | 0.254** |
| Final Year  | -0.081 | 0.410  | -0.097  | 0.036     | 0.688* | 0.049   | -0.052  | 0.681* | -0.052  |

Note. \* Correlation is significant at the 0.05 level (2-tailed). \*\* Correlation is significant at the 0.01 level (2-tailed).

Table-4 shows Correlation between Predictors (FSC, entry test and overall merit) and the First, Second, Third and Final year scores for overall sample of Engineering Students Discipline wise. The data show almost negative relationship, for all the three predictors with student’s scores, even up to final in Agriculture discipline.

In Civil discipline, entry test and overall merit have no significant relationship with the First, Second, Third and Final year scores while FSc marks show negative relationship. The relationship between FSc marks and students scores is significant at the 0.05 level while relationship of the entry test marks and overall merit with students scores up to final year show significant relationship both at the 0.05 and 0.01 level in Electrical discipline. In Mechanical discipline the data show no or negative relationship for FSc and overall merit. The entry test correlation was found significant with first and final year scores of Mechanical students. In Chemical discipline FSc and entry test marks have no significant relationship with student’s performance while overall merit shows significant relationship with the First Final year scores only at the 0.05 level.

In Mining discipline, FSc marks show negative relationship with the Second and Third year scores while the entry test and overall merit both have no significant relationship with the First, Third and Final year scores, although the correlation coefficient values are very high. Both entry test and overall merit have perfect positive significant relationship with the second year scores at both the 0.05 level and 0.01 levels.

Table-4 Discipline wise Correlation between Predictors and the First, Second, Third and Final year scores of Engineering Students

| Predictors | Criterion            | Agriculture<br>(N=6) | Civil<br>(N=60) | Electrical<br>(N=74) | Mechanical<br>(N=43) | Chemical<br>(N=15) | Mining<br>(N=5) |
|------------|----------------------|----------------------|-----------------|----------------------|----------------------|--------------------|-----------------|
| FSC        | First Year           | 0.982                | 0.005           | 0.381**              | -0.190               | 0.383              | 0.361           |
|            | 2 <sup>nd</sup> year | -0.058               | -0.011          | 0.274*               | 0.062                | 0.247              | -1.00**         |
|            | Third Year           | -0.393               | -0.094          | 0.258*               | 0.153                | 0.211              | -0.216          |
|            | Final Year           | -0.650               | -0.126          | 0.281*               | -0.206               | 0.135              | 0.710           |
| Entry test | First Year           | -0.772               | 0.149           | 0.628**              | 0.392*               | 0.098              | 0.901           |
|            | Second year          | -0.342               | 0.135           | 0.406**              | 0.171                | -0.156             | 1.00**          |
|            | Third Year           | -0.618               | 0.202           | 0.483**              | 0.002                | 0.206              | 0.919           |
|            | Final Year           | -0.361               | 0.133           | 0.269*               | 0.354*               | 0.379              | 0.995           |
| Merit      | First Year           | -0.263               | 0.135           | 0.588**              | 0.191                | 0.482              | 0.630           |
|            | Second year          | -0.466               | 0.083           | 0.285*               | 0.216                | 0.199              | 1.00**          |
|            | Third Year           | -0.512               | 0.069           | 0.358**              | -0.040               | 0.470              | 0.543           |
|            | Final Year           | -0.687               | 0.004           | 0.284*               | 0.160                | 0.541*             | 0.916           |

Note. \* Correlation is significant at the 0.05 level (2-tailed).

\*\* Correlation is significant at the 0.01 level (2-tailed).

#### 4. Discussion

Overall, our findings indicate that there is significant relationship between the Predictors (FSc, ETEA entry test scores and overall merit) and the academic achievement of engineering students. These results are conforming to the international studies about the validities of entry /admission test like GRE, SAT, MCAT, PCAT and GMAT etc. But for the female students and some engineering disciplines, the result is even more surprising as it shows that there is a negative relationship between the predictor's scores and the academic achievement. This is because analyses are based on comparatively smaller sample sizes of students (female were 7% of the total students only), so one could conclude that ETEA scores are not good predictors of academic achievement of female and some engineering disciplines.

Although much of the variability across studies could simply be attributed to sampling error, some of the remaining variability is likely due to differential restriction of range. We also acknowledge that our relatively small sample size placed a restriction on the power of the significance tests used in this study to detect actual difference or relationships and placed a similar restriction on the generalization of our results to future engineering students as well.

No corrections were made for restriction of range in this data, although such restriction almost certainly occurred (i.e. students are selected on the basis of ETEA entry test scores as well as FSc score ,which correlate strongly with entry test scores).This restriction of range results in an underestimate of the predictive power of the predictors(Nathan,R.K.2005). Therefore it is recommended that future research would examine the effect of multivariate restriction of range on entry test validities.

All of the evidence obtained here points to the entry test as a valid predictor of engineering student performance. It is, of course, not a perfect predictor of student success, and the development of additional predictors that emphasize non-ability determinants of student performance is likely to be of value. Presently, the admission criterion does not include an interview or test of non-cognitive domains of the students, which may also be included. However, these measures would be best used to compliment existing predictors rather than replace them.

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