Relationship Of Learning Outcome In Higher Education With Admission Criteria To "Faculty Of Engineering - Sana'a University"

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Abstract

This article outlines the methodology and result of a study designed to assess and develop the admission policy of applicants wishing to get admission to university engineering courses at Sana'a University (Yemen). The work provides evidence for admissions policy makers. Data for four academic years have been analysed. About 9000 applicants and students are included in the study. The correlations between learning outcomes in higher education and pre-university attainments have been investigated. The paper reports on the contribution of admission criteria for prediction of student success in higher education. Several admission scenarios have been considered. The results clearly indicate that the secondary-school score does not significantly influence the academic progress of the students. However, it is found that having an admission policy based on an admission test improves students' higher education performance. Results also indicate that gender plays a significant role in academic achievement.

Keywords: Higher education, admission policy, admission test, Sana'a University.

Nomenclature

MoHE	Ministry of Higher Education.
SSs	Secondary-School scores.
AT	Admission Test.
SAT	Average of secondary-school and admission-test scores.

1.INTRODUCTION:

Sana'a University is the biggest central government university in Yemen. The Faculty of Engineering, established in 1983, is the one of its major faculties. Entry into engineering courses is highly competitive, with demands exceeding the available places. Applicants are high performers who have already achieved exceptional results in their secondary school. The rules for admission to higher education in Yemen have been changed several times during the last two decades. An admission test has been introduced since 1998/1999 as an additional selection parameter on top of the secondary-school score (Sana'a University, 1998; Ministry of Higher Education, 1998). According to the adopted admission policy, to be eligible for engineering faculty:

1. Applicants should have achieved a minimum of 80 per cent in the secondaryschool certificate.
2. Applicants must take the admission test.

Applicants achieving the highest average of secondary-school and admission test scores are accepted, according to faculty capacity.

Higher educational institutions develop admission test to accommodate their policy and the educational system they employ (Rigol, 1999). Admission test is used as a primary element determining a student's admission to an institution of higher education. The goals of admission test are (Rigol, 1999; Australian Council for Educational Research, 2007):

1. Achieve fair competition and unified measurements for all applicants.
2. Make sure that all students have similar background in the important scientific subjects related to the higher education discipline.
3. Identify talented students for higher education.
4. Eliminate corruption at the stage of transferring from secondary schools to higher education.

Admission test is worldwide used and it has been well studied and acknowledged to be reasonable predictor of academic performance (Lievens and Coetsier, 2002; Arcelo, 2003; Lievens *et al.*, 2005; Weekley and Ployhart, 2006). Researchers compared success rate at higher education level for students, who were selected on the basis of secondary-school results with those who were selected on the basis of entrance test where contradictory results were found. The contradictory results among institutions are expected due to different factors such as secondary school outcomes, study field, admission test construction and gender (Clerici *et al.*, 2013). Henriksson and Wolming (1998) figured out that no significant difference was found between students admitted on the basis of secondaryschool results and students admitted on the basis of admission-test scores. However, Svensson *et al.,* (2001) and Trost (1995) found that secondary-school results were better predictors of study success than admission-test results. On the other hand, Liu (2008) stated that the admission-test scores

were a significant predictor of higher education success. It is found that some students who could not do well in their A levels (the British General Certificate of Education) scored high in admission test for higher education (Australian Council for Educational Research, 2007). Nevertheless, Beller (2000) has shown that the best prediction of study success was achieved by a combination of secondary-school and admission-test scores. Recently, Clerici *et al.* (2013) applied discrete-time competing risks survival analysis to study the determinant of Italian university students' performance in various fields of study. They investigated many covariates influencing the various outcomes of higher education (withdrawals, course changes, delays, and completion of degrees). They found that secondary school scores are powerful predictors in the expected direction of both withdrawal and degree completion. The score effect on course change is mixed. A higher score increases the risk of change in social sciences but decreases those in scientific studies, and no effects are found among students in professional health studies and humanities. This could can be attributed the fact that the scientific studies need high educational backgrounds. However, Belloc *et al.,* (2010) suggested this contradiction could be due to the fact that individuals with high educational backgrounds are more sensitive to courses and, when they realize they are not enjoying them, they change.

The students are the main stakeholder in the higher education. Therefore, they should be selected carefully. The present research reports on the contribution of admission criteria for prediction of student success in higher education. The results of the research are indicative not only for individual students, but also potentially for universities, in designing policies and interventions to prevent students from delays and withdrawals in higher education. The res-

earch will help the higher educational institutions to develop admission criteria to accommodate their policy and educational goals and objectives. As well as, the research will help the faculty of engineering, Sana'a University to select the suitable applicants.

Higher education institutions should monitor and evaluate the link between their admission policy, undergraduate performance and retention, and review their policy to address any identified issues (Admissions to Higher Education Review, 2004). It is worth mentioning that the admission policies of Sana'a University have never been evaluated. The purpose of present study is to identify student progress according to different scenarios of admission criteria. Consequently, the objectives of this study are to:

1. Explore different admission policies.
2. Evaluate admission policies according to the students' performance at the first year of bachelor degree.
3. Develop a new admission policy.
4. Provide evidence for admission policy makers.

2. STATISTICS

Admission test to undergraduate studies at Sana'a University vary across institutions according to their vision. Faculty of Engineering constructs and administrates its own admission test. It is a single test in Mathematics, Physics and English language subjects. It is a multiple choice test covered the syllabus of the secondary school. It consists of 25 items of each subject selected from item bank. Admission data of applicants has been analysed for four academic years, 2005/2006 up to 2008/2009 (Faculty of Engineering, 2006a; 2007a; 2008; 2009). The data was collected during the first term of the 2008/2009 academic year. It is noticed that the number of the applicants is higher than the capacity of the faculty which is assigned by the Ministry of Higher Education, MoHE (Ministry of Higher Education, 1998).

Figures 1 and 2 illustrate the contribution of each group of applicants and enrolled students, respectively, for four academic years. Candidates are classified into three groups according to their Secondary-School scores (SSs): group 1 ($85\% > SSs \geq 80\%$), group 2 ($90\% > SSs \geq 85\%$) and group 3 ($SSs \geq 90\%$). As shown in Fig. 1, the most applicants are from group one. The contribution of the other two groups of applicants is slightly increasing. However, as indicated in Fig. 2, enrolled students of group two are dominating. By the 2008/2009 academic year, 50 per cent of enrolled students are from group two.
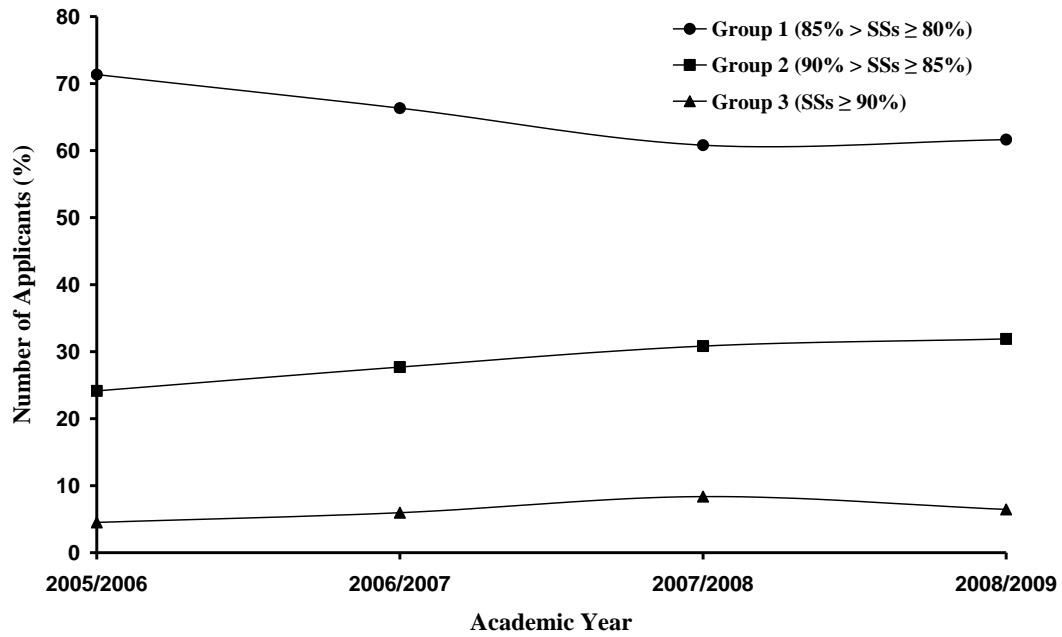
Fig. 1: Number of applicants sorted by secondary-school score (*SSs*) for four academic years.
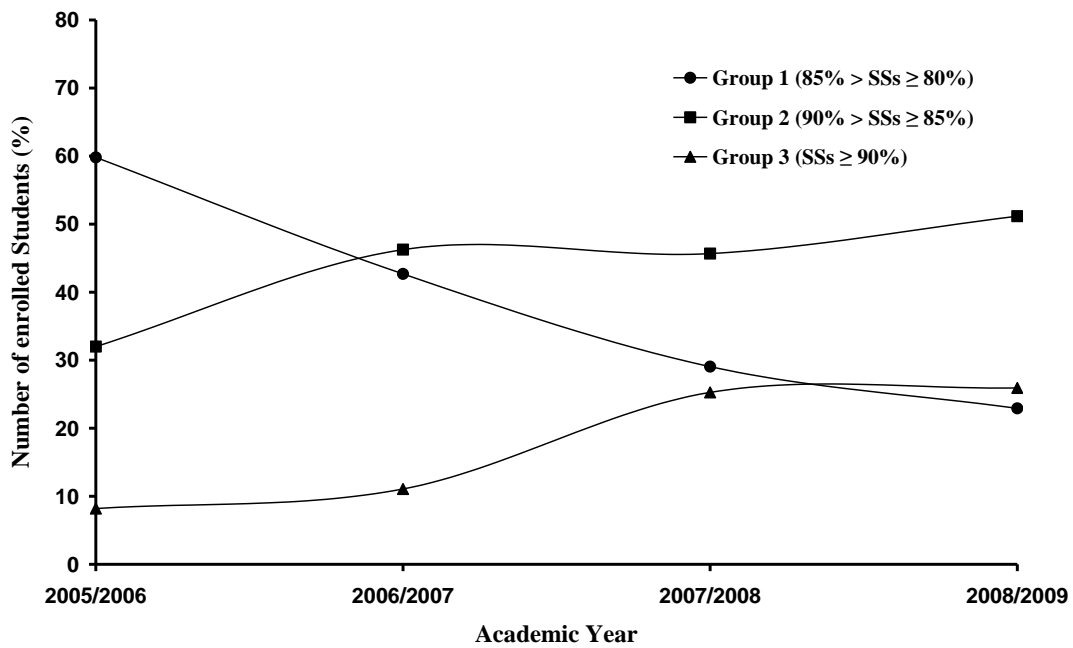

Fig. 2: Number of enrolled students sorted by secondary-school score (*SSs*) for four academic years.

3. ADMISSION CRITERIA

The evaluation of admission policy involves an inspection of different admission criteria that could be applied to the applicants. Five scenarios of admission criteria are considered according to:

1. Secondary-school score.
2. Admission-test score.
3. Average of both secondary-school and admission-test scores (it is the current admission criterion).
4. Average of selected subjects from secondary-school certificate.
5. Average of admission-test score and selected subjects from secondary-school certificate.

The first three admission criteria will be discussed on this section based on the applicants' data. Since the available applicants' data does not include detailed information of secondary-school certificate, the fourth and fifth admission criteria will be discussed later on based on students' data.

First, the admission data of the considered four academic years (Faculty of Engineering, 2006a; 2007a; 2008; 2009) is analysed. Figure 3, depicts the data of the applicants for the admission of 2007/2008 academic year. The curves show secondary-school and admission-test scores as well as their average scores against number of applicants. The secondary-school scores are drawn as a single curve which indicates that the minimum secondary-school score for applicants to be enrolled is 87.25 per cent. Using this score, the applicants are divided into two groups, A and B as shown in Fig. 3. This denotes that if admission criterion is secondary-school score, all enrolled students will form group A which is about 21 per cent of applicants. On the other hand, as shown in Fig. 3, admission-test scores are drawn as two curves, represented by groups A and B. It is clear that the applicants do not perform significantly high scores in admission test compared with secondary school. If admission criterion is admission test, the minimum score for applicants to be enrolled is 59 per cent. This indicates that only 42.1 per cent of the applicants from group A will be enrolled. Finally, average of the secondary-school

and admission-test scores will be considered as the third admission criterion. Two curves of average scores is constructed for each group (refer to Fig. 3). It is revealed that 51.8 per cent of applicants of group A will be enrolled with a minimum score of 72.1 per cent.

Three figures similar to Fig. 3 have been constructed for the rest of the academic years. It is found that these figures are comparable. Therefore, the main conclusion, extracted from these figures is shown in Table 1. The proportion of group B is dominating. By the year 2008/2009, 87 per cent of the applicants are from group B. Table 1 also shows the mean score of secondary school and admission test for each group. It is obvious that the secondary schools' national test outcomes are slightly improved. However, the outcomes of admission test are reasonably decreasing. It seems that the admission test is very hard for the majority of the applicants. It is found that the correlation coefficients between secondary-school and admission-test scores vary between 0.22 and 0.31. The low correlation between the two scores makes clear that applicants randomly respond to the admission test (Liu, 2008).

Table 1 also exhibits the portion of enrolled students and minimum entering score for three admission criteria, secondary school, admission test and their average. It is obvious that no applicants will be enrolled from group B if the admission criterion is the secondary-school score (refer to Table 1). According to the secondary-school score, group A students are knowledgeable than group B students. However, admission records of the last three years verify that group B is significantly outperformed group A on admission test. According to the records of the academic year 2008/2009, if the admission criterion is based on admission test, the enrolled students from group B are dominating. It is very ambiguous and

raises questions about the creditability of secondary school results. It is possible that the high score in secondary school of some applicants could be due to high marks in the subjects that are no related to science, such as Arabic language, Geography, and History.
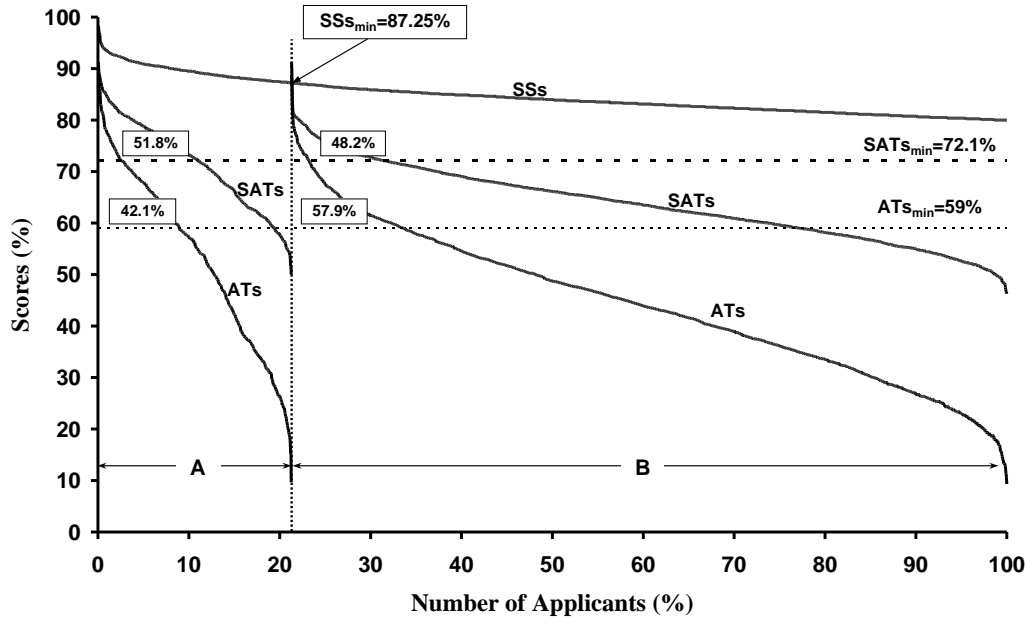

Fig. 3: Secondary-school score (SSs), admission-test score (ATs) and their average (SATs) of applicants for 2007/2008 academic year.

Table 1: Variables of the two groups of applicants, A and B; Percentage of proportions and mean values as well as portion of enrolled students and minimum scores for secondary-school score (SSs), admission-test score (ATs) and their average (SATs) admission criteria.

Variables		2005/2006		2006/2007		2007/2008		2008/2009	
		A	B	A	B	A	B	A	B
Proportion		48.2	51.8	33.3	66.7	21.3	78.7	13	87
Mean SSs		86.12	81.48	87.92	82.17	89.71	83.18	90.29	83.56
Mean ATs		69.83	64.67	59.4	52.77	53.27	43.87	46.18	33.75
SSs criterion	**Enrolled**	100	0	100	0	100	0	100	0
	Min. score	83.12		85		87.25		88.37	
ATs criterion	**Enrolled**	56.2	43.8	47.5	52.5	42.1	57.9	34.9	65.1
	Min. score	68.6		62.5		59		56	
SATs criterion	**Enrolled**	63	37	56.8	43.2	51.8	48.2	42	58
	Min. score	76.1		73.14		72.1		71.23	

4. EVALUATION OF ADMISSION CRITERIA

An initial concern in evaluating the outcome of this project is the extent to which the admission policy is comparable in the achievement of students. The significance of outcome-based criteria of admission is investigated. The progress of the students are evaluated after the first year at the faculty for two academic years 2005/2006 and 2006/2007 (Faculty of Engineering, 2006b; 2007b). The subjects taught at

the first year are more or less similar to what students had at secondary school. Therefore, it is relevant to use the results of the first year to assess the performance of different admission criteria. It is found that the students' first-year progress is the best predictors for completion of the academic programme (Tumen *et al.,* 2008).

4.1 Secondary-school score criterion

The comparison of mean and standard deviation of secondary-school scores for the two groups of students, A and B, at the first year are shown in Table 2 for two academic years 2005/2006 and 2006/2007. Moreover, an effect size is provided for each comparison. It is statistical way to indicate the magnitude of the performance difference between the two groups. It is calculated by dividing the mean difference by the pooled standard deviation. As a general rule of thumb, effect size of less than 0.25 is considered small, effect size of 0.5 is medium, and effect size greater than 0.75 is classified as large effects (Cohen, 1988). Therefore, as revealed in Table 2, the performance difference between the two groups in secondary-school achievements is very large effect size on the two consecutive academic years. Contradictory, Fig. 4 exhibits that A and B are matched groups in terms of higher-education achievements. Group A doesn't show significant superior achievements than do students from group B. However, group A surpasses group B by about 2-4 per cent. Subsequently, the secondary-school score of the students has no significant effect on the performance of the students at higher education. In general, the mean performance of the students at the first year is about 68 per cent which is not very good (see Fig.4).

Table 2: Statistics of the first-year students' secondary school data.

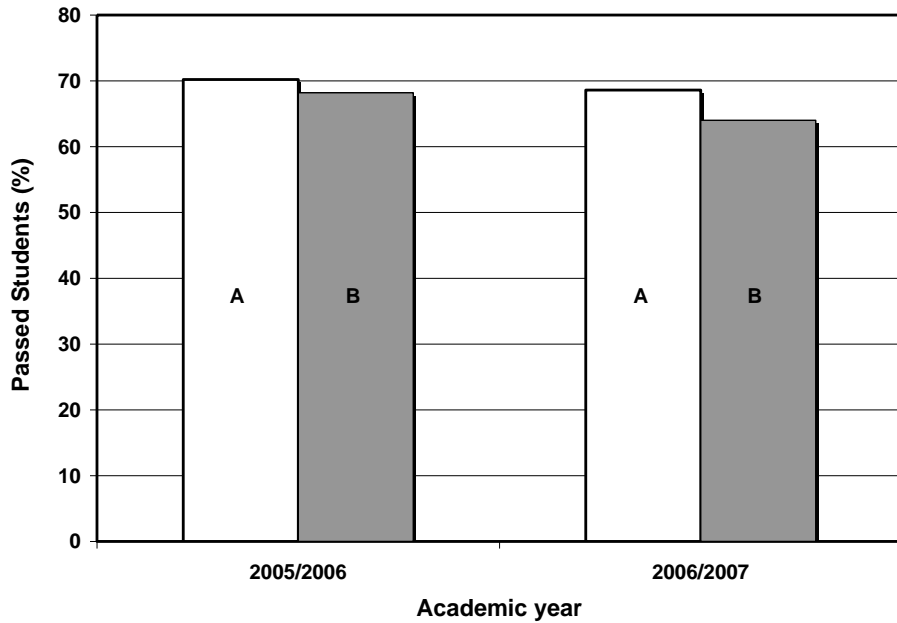| Variables	2005/2006		2006/2007	
	A	**B**	**A**	**B**
Number	315	185	284	216
Mean score (%)	86.52	81.65	88.08	82.64
Standard deviation	2.78	0.94	2.29	1.49
Effect size	2.62		2.88	

Fig. 4: Percentage of students passed the first year; sorted in two groups A and B according to secondary-school score.

The correlation between passed students and their respective secondary-school scores is shown in Fig. 5. The value in brackets shown above the trend line is correlation coefficient. The graphs can be interpreted as that the progress of the students is slightly improved in accordance with the secondary-school score at the year 2005/2006 while the achievement is deteriorated at the year 2006/2007. It is obvious that the achievement in higher education is independent of the secondary-school score.
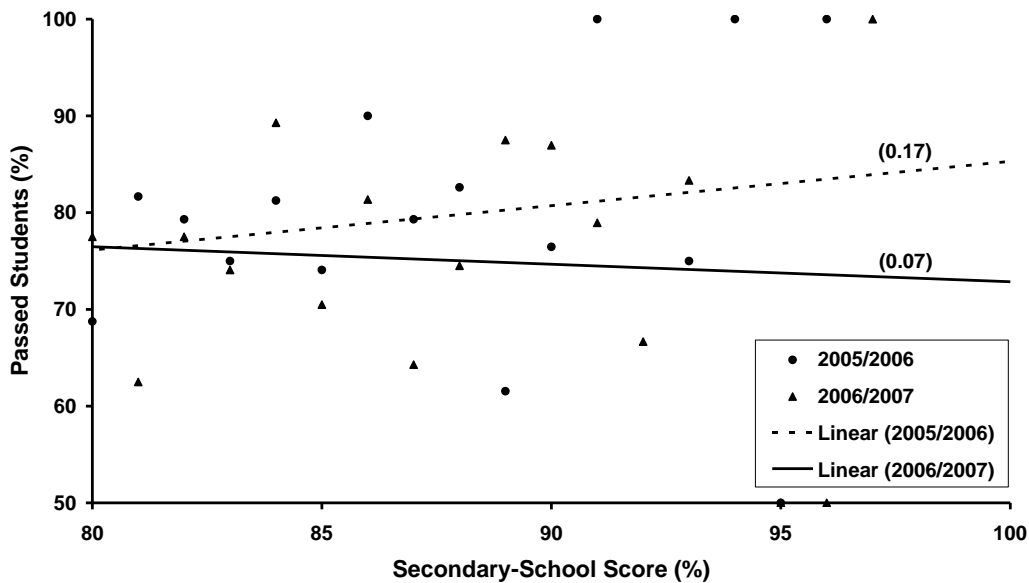

Fig. 5: Passed students according to their respective secondary-school scores; values in brackets are correlation coefficients.

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On the other hand, gender differences in educational achievement have attracted particular attention in the literature, with many of the reviewed studies stressing an increased likelihood of completion associated with women rather than men (e.g. Tumen *et al.,* 2008). Table 3 shows percentage of students passed the first year classified according to gender for two academic years. As expected, female students did better than male student.

Table 3: Percentage of students passed the first year; sorted out according to gender.

Gender	2005/2006	2006/2007
Male	72	65
Female	84	90

4.2 Admission-test score criterion

Figure 6 shows the progress of the first-year students according to their respective performance in the admission test. It is found that for both considered years the progress of the students is highly dependent on the success on the admission test. These results indicate that admission test is technically sound and provided sufficiently reliable results for use as admission criterion.
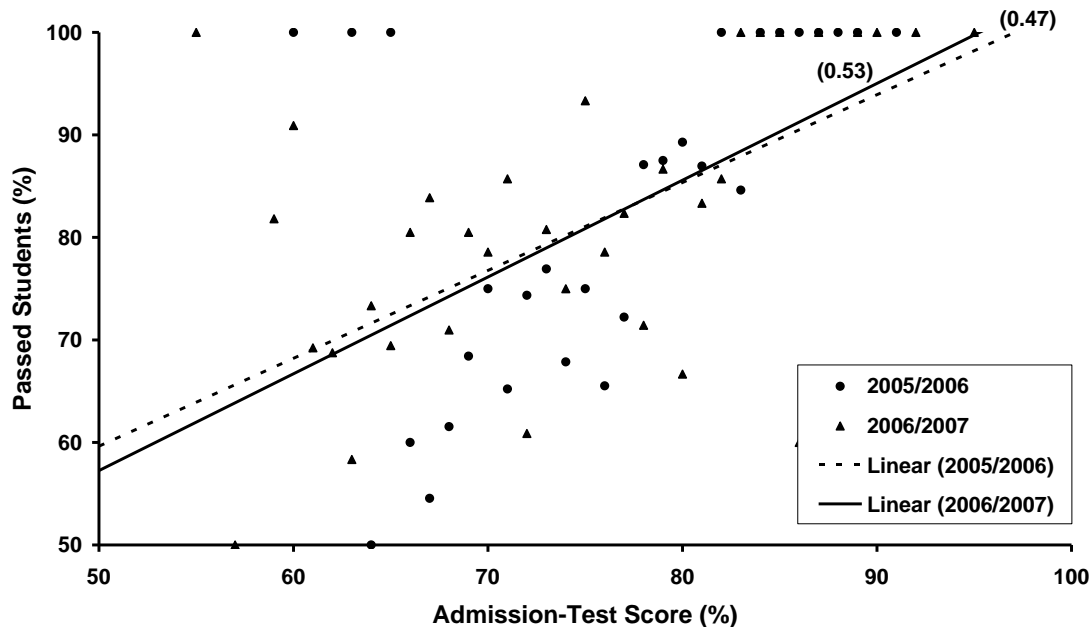

Fig. 6: Passed students according to their respective admission-test scores; values in brackets are correlation coefficients.

4.3 Average of selected subjects of secondary school' criterion

The fourth admission criterion based on the average of selected subjects from the secondary-school certificate, will be discussed. Consequently, the conclusion for the fifth admission criterion, which is the average of the above criterion and admission-test score, has been drawn. The selected subjects from the secondary-school certificate are chosen to be similar to the subjects

of admission test, which are Mathematics, Physics and English language. The students at the first year have been categorised according to their respective scores in the three subjects. It is found that about 30 per cent of the students have average of the three subjects higher than the secondary-school score. Figure 7 illustrates the progress of the first-year students according to their respective average of the three subjects. For the academic year 2005/2006, the

trend line of scatter data clarifies that the achievement of students is slightly improved. However, the trend line of the academic year 2006/2007 verifies the dependent of the achievement of students on average of the attained three subjects.
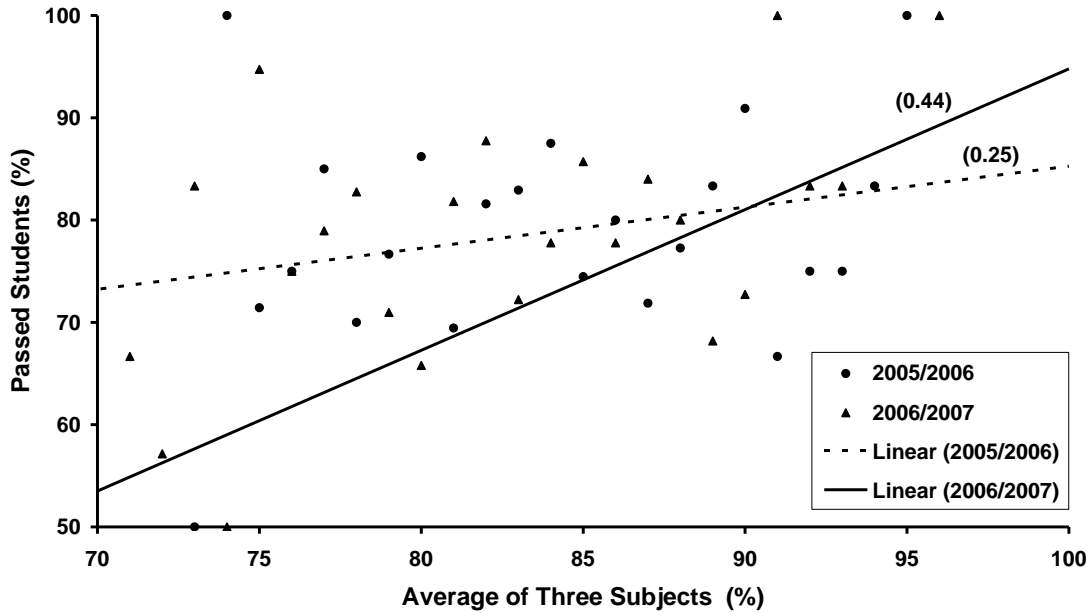
Fig. 7: Passed students according to their respective average score of the three subjects; values in brackets are correlation coefficients.

4.4 Comparison

In order to make an appropriate and easy comparison of the students' achievement for different admission criteria, the mean trend lines of the two considered academic years for each criterion shown above (Figs. 5-7) are constructed in Fig. 8. The admission criterion based on admission test exhibits higher correlation coefficient. Therefore, the achievement of the students, based on the admission-test criterion as admission policy, is excellent and beat the other criteria. Moreover, the criterion based on the average of three subjects also scores somewhat higher success. However, it is found that secondary-school score does not affect the academic progress of the students at higher education. These data provide significant evidence of the instructional soundness of the admission policy counted on admission test in accelerating students learning in the first year. As the data of Fig. 8 demonstrates, for the scores between 80 per cent and 85 per cent, the achievements of the students based on the secondary school is higher than achievements based on average of the three subjects. However, by the score higher than 85 per cent, achievements of the students based on average of the three subjects are outscored.

5. CONCLUSIONS AND RECOMMENDATIONS

The paper assesses and develops the admission policy of the Faculty of Engineering, Sana'a University (Yemen). Different admission criteria have been considered and assessed against the progress of the students at the first-year of higher education. The admission data for the academic years 2005/2006 until 2008/2009 is considered. Meanwhile, the progress of the students is assessed against the results of the academic years 2005/2006 and 2006/2007.
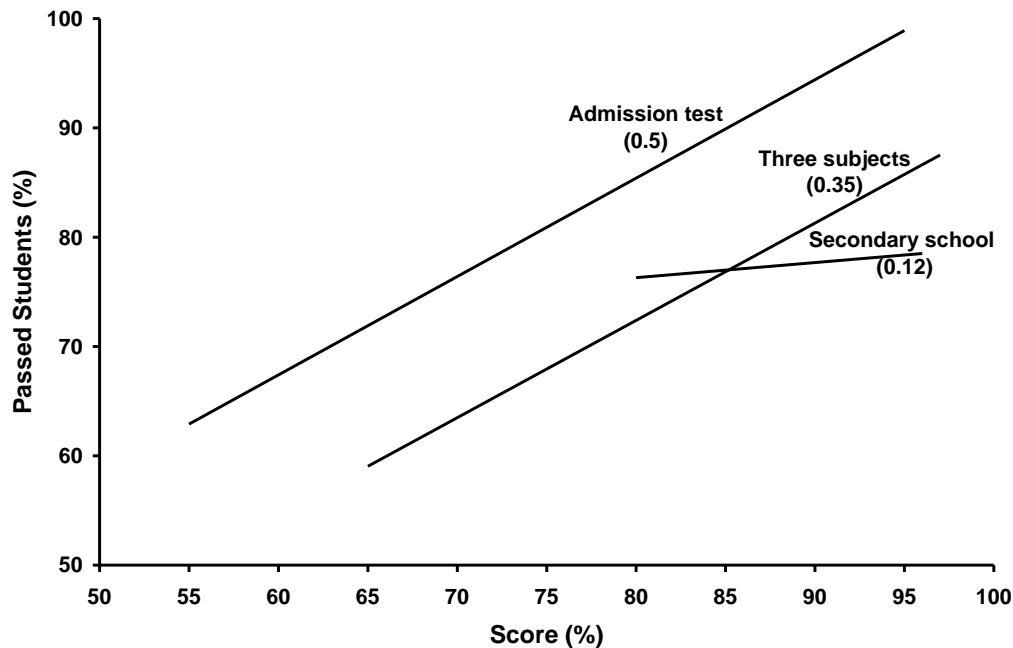
Fig. 8: Comparison of the mean percentage of passed students for different admission criteria; values in brackets are mean correlation coefficients.

The authors have considered assorted admission criteria based on the scores of secondary school, admission test, and average of selected subjects from the secondary-school certificate. Moreover, a dual combination of the mentioned admission criteria is also considered. It is found that the secondary-school score does not affect the academic progress of the students in higher education. The admission criterion based on average of selected three subjects of the secondary-school certificate (Mathematics, Physics and English language) reveals reasonable progress of the students. Nevertheless, the findings reveal that the students with high score in admission test show significantly marvellous achievements. Therefore, admission test assesses educational outcomes of high-school students before admission to higher-education institutions. However, the admission-test construction and the performance of the applicants need to be assessed.

The study concludes that the current admission policy implemented to higher education which is a combination of the admission-test and secondary-school scores does not provide the best means of predicting student achievements. Therefore, it is recommended that the current admission policy should be modified. The recommended admission policy is either the admission-test score only or the average of the admission-test score and marks obtained among three subjects of secondary-school certificate. Although, the number of applicants scoring higher than 85 per cent in secondary school is increasing annually, it is recommended that minimum score of secondary school of applicants to be eligible for enrolment should remain 80 per cent. This will give a chance to a wide range of applicants to participate in the challenging entrance test which led to highly selective admission and improvement in the quality of intake. It is believed that the admission test is able to identify students who are likely to succeed at university despite not achieving

secondary-school scores.

Readers are encouraged to judge for themselves, the extent to which the reported results are generalized to other higher-education institutions. Particularly, the author would like to encourage other institutions in Yemen and Gulf states to conduct similar study. The author is aware that in order to reach more reliable results, both available data and statistical techniques need to be improved.

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علاقة الأداء الجامعي بمحكات القبول للتعليم الجامعي
"دراسة لكلية الهندسة – جامعة صنعاء"

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المُلَخَّصْ

تكمن أهمية هذه البحث في محاولة التعرف على عملية انتقاء المدخل الرئيسي وهم الطلاب الجدد في العملية التعليمية في كلية الهندسة – جامعة صنعاء. لأن عملية تقييم مستوى الأداء في العملية التعليمية في الكلية تتأثر مباشرة بمستوى التحصيل العلمي لدى الطلاب في التعليم ما قبل الجامعي. وبالتالي فقد تم في هذه البحث عمل دراسة تحليلية لعملية التنسيق والقبول للأعوام الجامعية الدراسية ٢٠٠٥/٢٠٠٤م وحتى ٢٠٠٩/٢٠٠٨م بهدف التعرف على تأثير سياسة التنسيق والقبول المطبقة حالياً في انتقاء الطلاب المقبولين في الكلية. ولقد بينت هذه الدراسة أن آلية التنسيق والقبول المتبعة لها تأثير إيجابي في عملية اختيار الطلاب حيث تبين ان معدل الثانوية العامة لا يعتبر مؤشرا للمستوى الحقيقي للطلاب المتقدمين والمقبولين للدراسة في كلية الهندسة ولا يمكن فرز الطلاب بناءً عليه. كما بينت الدراسة أهمية امتحان القبول في سياسة القبول وذلك لأن فرز الطلاب بناءً على امتحان القبول قد أرتبط مع نتائج أداء الطلاب في الدراسة الجامعية الكلية.

كلمات مفتاحية: التعليم العالي– سياسة القبول – امتحان القبول – جامعة صنعاء.