Studying the Relationship between Students' Performance in Scientific Examination and Their Academic Achievement in Third Year of High School

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Abstract- Every year, large amount of money is spent on production and application of academic advancement and entrance exams to special schools. They have both negative and positive impacts. The purpose of the current research is to study relationship between students' performance in scientific exam and their academic achievement in third year of high school in Shiraz, Iran. The statistical population for this study includes the entire students, both male and female, who have been graduated from high school in 2010-2011 academic years in Mathematics and Physics (MP), Experimental Science (SE) and Human Science (HS) from district two of Shiraz Education Organization. The number of students in our sample was 2151 including 1145 students in the field of MP, 779 in SE, and 218 in HS. Of the whole population, 1533 were females and the remaining (618) were male.

Keywords- Performance; Academic Achievement; Scientific Examination.

I. INTRODUCTION

The fulfillment of all education goals including general, specific, and behavioral goals is done only through a dynamic educational system. Every textbook is of the definite objectives. Both teachers and students together share activities to get those objectives. One of the main duties of an educational system is to measure the students' achievement to see whether they are of enough knowledge to pass the course or they should repeat it. Teachers are always looking for the best way to evaluate the students learning process.

Based on literature, about 4000 years ago Chinese officials examined applicants through a test to select their employees. According to reliable documents, the test was used in the ancient Persia as well. For example, in Jondishapoor, some exams were held for the students of medicine at the time of Shahpur, Sassanid King. In the seventh century in Mostansaryhe school applicants were also tested to be chosen. In the late Zandieh and early Qajar period, some orally and individual test were held in the presence of scientists to

investigate whether children had learned the religious instructions or not.

According to [2] evaluation is a process in which one tries to collect information about a phenomenon and the gathered information is applied to verify phenomenon. Evaluation measures how much a phenomenon owns a certain feature.

Test is the means of measurement which is defined by [1] as a systematic method or means to measure a sample of behavior. Nowadays, in most high schools the officials hold exams to prepare students for university entrance exams and improving their scientific achievement. Every year, a large amount of money is spent on holding the educational progress tests and entrance exams of special schools which accompanies some positive and negative effects. These tests are important based on two criteria: Firstly, degree of closeness to the standard test and secondly, their capability to evaluate students' achievements. Since the reliability of the results depends on the method of performing a test, it may have negative influence on the main objectives of the test. Therefore, in this research, the main principles of multiple choice exams as a performing method and the differences between an ordinary test and a standard test will be discussed.

II. STATING THE PROBLEM

Based on the way a test is prepared, one can divide all the different types of tests used in the ministry of education into two types: 1) Teacher-made test, 2) Standard test. They are explained as follows:

- Teacher-made tests: Teachers prepare these tests to evaluate students' educational achievement both during and at the end of the courses and they are designed to determine students' success in reaching to the defined educational goals.

- Standardized: Standard tests are prepared and distributed by experts in different governmental and private test design institutes or education centers to evaluate the students' achievement or their intelligence. In this type of test, relative criterion of measurement is used.

III. RESEARCH OBJECTIVES

A. Main objective

The main goal of the present study is to investigate the relationship between students' performance in scientific examination and their academic achievement in the third year of high school in Shiraz.

B. Research Questions

1) Is there any relation between the written average of the tests and the total T-score?

2) Is there any relation between the written average of the tests and the total T-score of courses of nationwide final exams in scientific exam?

3) Which courses in the scientific tests are the best predictions for students' written average in the third year of high school?

4) Which of the mentioned field studies is of the greatest discrimination coefficient in the scientific exam?

5) In which fields the reliability of test is higher?

IV. METHODOLOGY AND INSTRUMENT

The population of this statistical study is all male and female graduated students of Shiraz high schools from mathematics, experimental science, and humanities fields. The sample of the study is male and female graduated students of Shiraz high schools in second district who took part in scientific tests in the above-mentioned fields of the study. The number of the sample is 2151 including 1154 students in mathematics, 779 in experimental sciences, and 218 in human science. The male students' number in the mentioned field studies was 464, 126, and 28 and the female students' number was 691, 653, and 190 respectively.

the significance level of one percent. Furthermore, this correlation coefficient in the Males' results is 0.64 and in the Females' results is 0.7. It is significant at the one percent level which is an indicative for higher degree of correlation between two mentioned variables in Females' results than Males' results.

Correlation coefficient between written average and the total T-score of nationwide final exams courses in achievement test in Females' and Males' groups is 0.71 and 0.65 respectively. The difference between them is similar to the two previous variables.

According to results of table III, the correlation coefficients between the written average and the total T-score of scientific test for the students of mathematics, experimental sciences, and human science are 0.63, 0.76, and 0.68 respectively. All results are significant at the one percent level. Therefore, it can be concluded that it is more difficult for students of mathematics to answer questions of scientific test.

The sources of data bank utilized in this study were the database of high school student in the second district of Shiraz and data from scientific test held in the same year.

V. STATISTICAL METHODS

One of the most reliable soft-wares available for statistical analysis of data related to behavioral research is the SPSS software which was utilized to analyze the data. To answer all research questions, in addition to descriptive statistics, Pearson correlation coefficients, F-test, T test, linear regression, variance analysis, discrimination index, facility index, and reliability factor were applied.

VI. RESULTS

In this study the objectives are analyzed by using various indices and statistical methods. Indices such as median, standard deviation, and correlation coefficient of different variables are computed. The effects of the explanatory variables on the dependent variables are estimated through regression models. T test and F test were used to compare the variable medians.

Table I (at the end of paper)

The correlation coefficient was used to observe relationship between the analyzed variables. The result of this computation is shown in Table II.

Table II (at the end of paper)

The results presented in table II indicate that the correlation coefficient between the written average and the T-score of the scientific test is 0.68 with

TABLE III. CORRELATION COEFFICIENT BETWEEN VARIABLES ACCORDING TO FIELD STUDY AND SEX.

Variable		Total Average	Total T-score of courses of nationwide final exams	Total T-Score	Written Average
Written Average	MP field	0.93	0.68	0.67	1
		0.9	0.63	0.62	1
		0.9	0.64	0.63	1
	ES field	0.95	0.78	0.77	1
		0.92	0.73	0.74	1
		0.94	0.77	0.77	1
	HS field	0.84	0.69	0.69	1
		0.78	0.37	0.37	1
		0.86	0.68	0.68	1
Total T-Score	MP field	0.63	0.98	1	0.64
		0.6	0.99	1	0.62
		0.57	0.99	1	0.63

	ES field	0.76	0.99	1	0.77
		0.74	0.99	1	0.74
		0.73	0.99	1	0.76
	HS field	0.66	0.96	1	0.69
		0.33	1	1	0.37
		0.65	0.97	1	0.68
Total T-score of nationwide final exams courses	MP field	0.64	1	0.98	0.68
		0.6	1	0.98	0.63
		0.57	1	0.99	0.64
	ES field	0.76	1	0.99	0.78
		0.73	1	0.99	0.73
		0.74	1	0.99	0.77
	HS field	0.66	1	0.96	0.69
		0.31	1	0.96	0.37
		0.67	1	0.97	0.68
Total Average	MP field	1	0.64	0.63	0.93
		1	0.6	0.6	0.9
		1	0.57	0.57	0.9
	ES field	1	0.76	0.76	0.95
		1	0.73	0.74	0.92
		1	0.74	0.73	0.94
	HS field	1	0.66	0.66	0.84
		1	0.31	0.33	0.78
		1	0.67	0.65	0.86

The correlation coefficients between the written average and the total T-score of nationwide final exams courses in scientific test for the students of mathematics, experimental sciences, and human science are 0.64, 0.77, and 0.68 respectively with significance level of one percent and the correlation is approximately the same as correlation between written average and total T-score in scientific test.

The results show that correlation coefficient between the written average and the T-score of scientific test and also T-score of final courses in scientific test is 0.37 for male students in human science field which is not significant statistically. The correlation coefficient between total average and the two above mentioned variables is 0.31 for this group of students and it is not significant either. The important point is that correlation coefficient between written average and total average in female students of all field studies is higher than male students'. Furthermore; correlation coefficient between written average and total T-score in scientific test in female students of all field studies is more than male students'. For example, this coefficient in female students of human science field is 0.69 however, in male students is 0.37. In table 3 there is no coefficient with higher value between male students than female students.

Since many factors affect decision making in education planning, it is necessary to compare variables between male and female genders and fields. Considered variables were compared through T-test for both sexes. The results are shown in table IV.

TABLE IV. THE COMPARISON BETWEEN MALE AND FEMALE HIGH SCHOOL STUDENTS IN GRADE 3

Variable	Male		Female		T statistic with the assumption of variance equality	T statistic with the assumption of variance inequality
	S. D.	Average	S. D.	Average		
Total Average	1.66	15.8	1.65	16.8	-12.98	-13.01 **
Written Average	2.47	13.58	2.53	14.5	-7.82	-7.74 **
Total T-score	1962	5069	1756	5196	-1.14	-1.47
Total T-score of courses of nationwide final exam	1960	5067	1772	5206	-1.53	-1.59

** The findings are significant in one percent level.

According to table IV results, there is no significant difference between male and female scores in the total T-score and total T-score of courses of nationwide final exams in scientific test because the calculated t statistic has less value than its value in the table.

The total T-scores of scientific test for Males and Females in mathematics and experimental science are not significantly different because the calculated t statistic has value is less than the quantity obtained in the Table.

However, the total T-score of the test for Males and Females in human science are significantly different. In this field the average of the Females' total T-scores in scientific tests is higher than those of the Males'. This conclusion is consistent with the differences between total average and written average of male and female students in three field studies because the difference between total average and written average of male and female students in human science field is the most as well (table V).

TABLE V. COMPARISON OF THE VARIABLES BASED ON SEX AND FIELD

field			Total T-score	Written Average	*Total Ave.*
MP	Female	Ave.	5160	14.67	17.35
		S. D.	1773	2.4	1.4
	Male	Ave.	5131	13.76	16.08
		S. D.	1965	2.4	1.6
	T		-0.26	-6.3 **	-14.3 **
ES	Female	Ave.	5268	14.86	16.75
		S. D.	1859	2.7	1.7
	Male	Ave.	5044	13.52	15.26
		S. D.	2035	2.6	1.63
	T		-1.22	-5.14 **	-9.13 **
HS	Female	Ave.	5085	12.72	15.28

		S. D.	1262	1.84	1.3
Male	Ave.	4149	10.8	13.87	
	S. D.	1271	1.37	0.88	
T		-3.66 **	-5.32 **	-5.5 **	

** Findings are significant in the one percent level

A comparison was also done among variables of average score, total average score, total T-score and total T-score of courses of nationwide final exams in three fields. Since comparison of three variables together will not be accomplished through T test, for this case variance analysis and F test were used instead of T test. The result is shown in table VI.

TABLE VI. COMPARISON OF VARIABLES AMONG THE STUDENTS OF THE THREE FIELDS WITH MEAN AND STANDARD DEVIATION

Variable	S. D.	Average	Significance Level	F
Total Average	1.72	16.54	0	65.93 **
Written Average	2.56	14.24	0	103.93 **
Total Score	1818	5160	0.151	1.89
Total T-score of courses of nationwide final exams	1829	5167	0.219	1.52

The table F value is 4.60 at one percent significance level and is equal to 2.99 at five percent significance level. The results of table 6 show that the variables such as total average and written average in three fields are significantly different because the F value is greater than the value obtained in the table. It is significantly different at one percent level. However, the other two variables, the T-score and the T-score of courses of nationwide final exams, are not significantly different in all three fields.

To find out the effects of the total T-score of different courses in scientific test as independent variables on the written average as a dependent variable, the regression analysis was used. The applied regression model is as follows:

$$MOKAT = \beta_0 + \beta_1 TK1 + \beta_2 TK2 + ... + \beta_{11} TK11$$

MOKAT is written average. TK1 - TK4 are T-scores of general courses such as Religion, Persian literature, Arabic and English respectively. TK5 - TK11 show the T-scores of special courses which are different based on each field. B,s Are the parameters which should be estimated. Estimated regression results are given in table VII.

The results obtained from regression model estimation for all students in table VIII show that all independent variables except courses 5, 7, 8, and 10 have significant positive effect

Variable	Standard Deviation	Average
Course1 (TK1)	1948	5212
Course2 (TK2)	1823	5170
Course3(TK3)	2000	5109
Course4(TK4)	1931	5181
Course5(TK5)	1948	5045
Course6(TK6)	1974	5094
Course7(TK7)	1933	4975
Course8(TK8)	1906	4991
Course9(TK9)	1929	5068
Course10(TK10)	1962	5060
Course11(TK11)	1986	5062

(TABLE VII. MEAN AND STANDARD DEVIATION OF EXPLANATORY VARIABLES IN THE REGRESSION MODEL)

Results show that average score of students in religion course is higher than other courses (5212).

The first regression with consideration of all students' written average and the T-score of all courses in scientific test is calculated. The estimated regression results are given in table VIII.

TABLE VIII. ESTIMATION OF REGRESSION MODEL FOR ALL STUDENTS

	Significance Level	T	SD.	Coefficient
Course 1	0	3.91	0.000024	0.000092
Course 2	0	15.08	0.000028	0.00042
Course 3	0	6.77	0.000024	0.00016
Course 4	0	5.68	0.000024	0.00014
Course 5	0.004	2.9	0.000023	0.000067
Course 6	0	4.46	0.000023	0.0001
Course 7	0.181	1.34	0.000023	0.00003
Course 8	0.004	2.89	0.000024	0.000069
Course 9	0	10.14	0.000024	0.00024
Course 10	0.024	2.26	0.000022	0.000049
Course 11	0	3.93	0.000021	0.000089
Function Constant	0	35.96	0.189	6.81
$\bar{R}^2 = 0.48$		$F = 155$		

on dependent variables because all are statistically significant at one percent level.

These variables all together explain the 48% change in average score. The F value shows that whole regression is significant because the F value is significantly greater than the F value obtained in the table. The coefficients of courses 9 and 2 are the highest, that is, in scientific tests the scores of these courses have more effect on the change of written average. The results are presented in table IX.

Regression model has also been computed to determine the effect of scientific test scores on written test average based on field studies. The results of this model evaluation are shown in table IX.

Results of regression estimation for all fields in table IX shows the variables TK6, TK7, TK10 and TK11 in mathematics are not statistically significant.

Other variables have positive and significant effective on written average. The value of determination index or   is 43% which indicates that 43 percent of variable change is dependent upon independent variables in the described model. F value in the regression model shows that the regression is statistically significant. The highest effect is related to course 2 (TK2) whose coefficient is equal to 0.00036. It means that a unit increase in the scientific test score of second course leads to 0.00036 unit increase in the written average.

In the regression model related to the students of experimental science field, variables TK5, TK7, and TK8 are not statistically significant and the other variables all have positive and significant effect on written average as a dependent variable. The regulated determination index for mathematics students is equal to 61.5% which is the highest value among the other three fields, that is, scores of scientific tests explain 61.5 percent of change in average score or in the other words, 61.5 percent of changes in written average score can be explained by scores of courses in scientific test. The F value is high which shows that the whole regression is significant. The highest coefficient is related to course 2 which is equal to 0.0005. The regression estimation for students of human science shows that variables TK3, TK4, TK5, TK6, TK7 and TK8 are not statistically significant at one percent level. However, other coefficients are significant and have positive effect on written average. F value shows that the whole regression is significant at one percent level. The regulated determination index shows that about 49% of changes in dependent variable (written average score) can be explained by independent variables. The highest coefficient in the regression model is related to TK11.

According to table X, the highest discrimination index in mathematics field is related to foreign language course and the lowest one is related to computer course. The most difficult questions are in computer test and the easiest ones are in religion course.

(TABLE X. DISCRIMINATION AND DIFFICULTY INDEX OF COURSES IN MATHEMATICS FIELD IN THE SCIENTIFIC TEST (NUMBER OF EVALUATED STUDENTS: 513))

Row	Course Name	Discrimination Index	Difficulty Index
1	Religion	0.49	62
2	Literature	0.46	58
3	Arabic Language	0.6	41
4	English Language	0.68	52
5	Physics	0.52	35
6	Chemistry	0.48	34
7	Algebra	0.39	27
8	Geometry 2	0.51	38
9	Mathematics and Calculation	0.37	25
10	Computer	0.33	24
11	Current History	0.49	35
	Average	0.44	36

According to table XI, it is clear that in this field the highest discrimination index in the experimental field is related to foreign language course and the lowest one is related to math course. The most difficult questions are in math and the easiest ones are in religion and literature courses.

(TABLE XI: DISCRIMINATION AND DIFFICULTY INDEX OF COURSES IN EXPERIMENTAL SCIENCE FIELD IN THE SCIENTIFIC TEST (NUMBER OF STUDENTS EVALUATED: 360))

Row	Course Name	Discrimination Index	Difficulty Index
1	Religion	0.51	55
2	Literature	0.47	55
3	Arabic Language	0.53	37
4	English Language	0.66	47
5	Physics	0.41	32
6	Chemistry	0.48	35
7	Mathematics	0.4	29
8	Modeling and Statistics	0.48	34
9	Biology	0.51	44
10	Geology	0.41	32
11	History	0.45	38
	Average	0.44	37

According to table XII, the highest discrimination index in human science field is related to psychology course and the lowest one is related to math course. The most difficult

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questions are in math test and the easiest ones are in sociology course.

(TABLE XII: DISCRIMINATION AND DIFFICULTY INDEX OF COURSES IN HUMAN SCIENCE FIELD IN THE SCIENTIFIC TEST (NUMBER OF STUDENTS EVALUATED: 149))

Row	Course Name	Discrimination Index	Difficulty Index
1	Religion	0.48	48
2	Literature	0.41	45
3	Arabic Language	0.47	36
4	English Language	0.43	34
5	Sociology	0.49	53
6	Psychology	0.54	47
7	Mathematics	0.36	30
8	Iran's History	0.39	31
9	Geography	0.53	41
10	Array of Literary	0.51	38
11	Philosophy and Logic	0.46	40
	Average	0.42	37

In which major reliability of the scientific test is the highest? Reliability index of the whole test is 0.88 which has a high value. The highest reliability index is 0.91 and it related to the the scientific test of experimental science field. The

VII. CONCLUSION

The statistical methods used in this study are: mean standard deviation, correlation coefficient, analysis of variance, t- test and analysis of regressions. The results are as follows:

1) The correlation coefficient between total T-score of entire test and written average is 0.68. This coefficient is 0.91 between total average and the average in written test and is 0.99 between total T- score and T- score of courses of nationwide final exams, and all of them are significant at the level of 0.01.

2) The correlation coefficient between the written average and the total average with total T- score for females is higher than males in each field.

3) The correlation coefficient between the written average and the total T-score of courses of nationwide final exams in scientific tests for MP field is 0.64, for ES field is 0.77 and, for HS field is 0.68. All of them are significant at the level of 0.01.

4)There is a significant difference (P<0.001) between written average and the total average of males and females in general and in each field. Females' average is higher than males in all the cases. But there is no significant difference between the total T- score between males and females.

5)There is a significant difference (P<0.001) in the variables of the total average and the written average between students of the three fields. MP students have the highest and HS students have the lowest average.

6)The results of regression model shows that the scores of courses in scientific exam in MP, ES and HS fields have 43%, 61.5% and 49% chance of prediction of the written average respectively.

7)The determination index of the test questions is 0.43 in total and the difficulty index of them is 0.37. This indicates that the difficulty of the exam is high. The average determinations index in MP, ES and HS fields is: 0.44, 0.44 and 0.42 in order.

8)The reliability index for MP, ES and HS fields is 0.87, 0.91 and 0.8 respectively.

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TABLE I. MEDIAN AND STANDARD DEVIATION OF GIVEN VARIABLES BASED ON SEX AND FIELDS OF STUDY

Variable	MP Field				ES Field				HS Field			
	Male		Female		Male		Female		Male		Female	
	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD	Ave.	SD
Total Average	16.08	1.59	17.35	1.39	15.26	1.63	16.75	1.69	13.87	0.88	15.28	1.31
Written Average	13.76	2.4	14.67	2.39	13.52	2.6	14.86	2.65	10.78	1.37	12.72	1.84
Total T-Score of the test	5131	1965	5160	1773	5044	2035	5268	1859	4149	1271	5085	1262
Total T-Score of nationwide final exams courses	5145	1967	5152	1749	4985	2010	5287	1867	4140	1302	5129	1287

TABLE II. THE RELATIONSHIP BETWEEN VARIABLES ALL OR BY SEX THROUGH USING CORRELATION COEFFICIENT

Variable	Written Average			Total Score			Total T-score of nationwide final exams courses			Total Average		
	female	male	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Written Average	1	1	1	0.64	0.7	0.678	0.65	0.71	0.684	0.89	0.91	0.91
Total Score	0.64	0.7	0.678	1	1	1	0.99	0.99	0.988	0.62	0.64	0.617
Total T-score of nationwide final exams courses	0.65	0.71	0.684	0.99	0.99	0.988	1	1	1	0.62	0.64	0.62
Total Average	0.89	0.91	0.91	0.62	0.64	0.617	0.62	0.64	0.62	1	1	1

TABLE IX. RESULTS OF REGRESSION MODELS ESTIMATION BASED ON FIELDS

Variable	MP			ES			HS		
	Significance Level	S. D.	Coefficient	Significance Level	S. D.	Coefficient	Significance Level	S. D.	Coefficient
Course 1	0.0003	0.000032	0.000097	0.031	0.000037	0.00079	0.001	0.000054	0.00019
Course 2	0	0.000037	0.00036	0	0.000045	0.0005	0.005	0.000069	0.0002
Course 3	0	0.000032	0.00017	0.009	0.000039	0.0001	0.283	0.000059	0.000064
Course 4	0	0.000033	0.00012	0	0.000037	0.00016	0.138	0.000056	0.000083
Course 5	0	0.000034	0.00017	0.837	0.000033	0.0000067	0.015	0.000058	0.00014
Course 6	0.07	0.00003	0.000056	0.001	0.000036	0.00012	0.048	0.000056	0.00011
Course 7	0.29	0.000033	-0.000035	0.036	0.000035	0.000073	0.543	0.000049	0.00003
Course 8	0	0.000033	0.00013	0.829	0.000037	0.0000079	0.745	0.00005	0.000016
Course 9	0	0.000032	0.00019	0	0.000037	0.0003	0.001	0.000054	0.00019
Course 10	0.144	0.000029	-0.00004	0.008	0.000034	0.00009	0	0.000064	0.0003
Course 11	0.404	0.000029	0.000023	0	0.000033	0.00014	0	0.00005	0.00021
Function Constant	0	0.26	7.93	0	0.27	6.5	0	0.6	4.28
	$\bar{R}^2 = 0.43$ $F = 80$			$\bar{R}^2 = 0.62$ $F = 114$			$\bar{R}^2 = 0.49$ $F = 20$		