

## REVIEW ARTICLE



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# A three tier system architecture design for factors affecting students' performance analysis in the Western region in Jeddah Universities

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## Abstract

**Objectives:** To study different factors influencing the academic performance of students at Jeddah University in Saudi Arabia. **Method:** The study sample included 164 participants from university of Jeddah, composed of 127 females and 37 males. A survey was conducted by using a questionnaire containing the different factors that could affect academic performance of university students. The questionnaire data were collected and analyzed by using SPSS version 25 statistical program. Descriptive and correlation analysis was made. Three-tier architecture is developed to enable us to make better decisions faster by analyzing data, shared data sources that are centralized and can be stored on different types of servers. **Findings:** A significant correlation between gender (female) and students' scores with Spearman correlation coefficient (r) value of 0.33. A significant correlation was noted between friendship/peer relation and students' scores with (r) value of 0.80. Family education, family relation and friendship/peer relation play an important role in Saudi student academic performance indicating that student culture and environment affect academic performance significantly. **Novelty:** The multitier architecture on which presentation, application processing and data management functions are physically separated; we are able to update and use a large data without any application update.

**Keywords:** Three tier architecture; academic performance; student; gender; Saudi Arabia; Family education; family relation

## 1 Introduction

Students' performance was highly interesting topic for several authors in different parts of the world. Education represents as an important tool for social and economic changes<sup>(1)</sup>. Education is essential to transform a society more civilized and well-disciplined<sup>(2)</sup>. We know that the intelligence is not the only factor influencing success in education. That is why it is important to talk about

the role of the family in education. However, there are different factors that need to be considered in order to get more useful recommendations and increase the quality of the student's results. In previous works, different factors have been studied separately to improve the global results but we need to know which factor is related to which factor. Hence, we want to study the possible relationships between different factors and their impact on student's performance.

The aim of our study is to apply multiple factors used by previous works. The objective is to combine many factors and to generate all possible correlations to give us a semantic value of the used factors.

Thus, the study was made to investigate the different factors affecting performance and student knowledge in Saudi Arabia universities. These factors include gender, age, education of mother and father, family size, family relation and student friendship. The questionnaires include all the previous factors in addition to the student scores were distributed among university students in Saudi Arabia.

This paper is organized into five sections, this being the first one. On section 2, we review the literature and present the related work. Section 3 describes the used methodology and instrument. Section 4 presents the most important results of our conducted experiments. Section 4 describes our proposed approach. On section 5, the different results are discussed. Finally, section 6 points out conclusions and future work.

## 2 State of the art: Review of students performance

Educators around the world suggested that week performance of students is related to both student and parent. This is mainly because home is the first step for education where student learn social values and ethics even before the formal education is initiated. Education experts around the globe found that there are many external and internal factors affect the student performance<sup>(1)</sup>. The internal factors are those related to student him/herself and can be controlled by student; whilst, the external factors (educational environment) are out of control<sup>(1)</sup>. Educated parents become the first teacher<sup>(3)</sup>. It was found that student with educated parent are more likely to have better academic achievement than those with uneducated parent<sup>(3,4)</sup>. One study found that student scores and academic performance with educated parent is better than those with uneducated parent. In addition, student from educated parent tend to follow their parent in success<sup>(5)</sup>.

Family relation is another important factor for student academic performance. A study found that family type is statistically and significantly correlated with the child performance<sup>(6)</sup>. Most children nurtured with both parents, performed better when compared to their corresponding students from different family types<sup>(2)</sup>. Deep family relation improves student personality, enhance self-confidence, eliminates risk of depression and anxiety<sup>(7-14)</sup>. In contrast, weak family relation suggested to be responsible for student's failure and poor academic performance<sup>(15,16)</sup>. It was suggested that student under parent control will have more emotional stability and a positive world view and better academic performance<sup>(17)</sup>.

Many authors suggested that other factors include personal characteristics, and family socioeconomic status (SES) are key factors affecting students' academic achievement<sup>(18,19)</sup>. Family size is another important factor for academic performance. The relationship between family size and education outcomes, was mentioned by several authors<sup>(20,21)</sup>. It has been suggested that family size can influence children's education outcomes by two ways. First is "dilution effect," this indicate that the family resources will be diluted due to large number of children which will have a negative impact on children education<sup>(22)</sup>. Second is "spillover effect" which indicate that children can influence each other by learning-by-doing and this gives them more chance to learn from each other which will have a positive impact on education<sup>(23)</sup>.

Friendship or peer effect was previously studied. Friendship or peer can affect emotional, cognitive, and behavioral skills for student which in turn reflects on quality of academic performance<sup>(6) (24,25)</sup>. Many studies were made on the impact of Friendship/peer influence on student performance they conclude that peer influence has more effects than family<sup>(26-28)</sup>. Peer help was positively associated with the students' academic performance. A study found that through peer interaction, students can improve their skills on solving sophisticated problems<sup>(29)</sup>. Peer teaching will

also encourage student's participation in study and academic achievement. A previous study found that mixing skills influence weak students positively but brilliant students were affected negatively<sup>(30,31)</sup>. It was found that uniform or homogeneous group students do better than heterogeneous group students<sup>(32)</sup>.

Gender and academic performance were reported from previous studies. A study examined the influence of gender on the student's performance and concluded that male students are not better than female students<sup>(33)</sup>. Whilst, another study concludes that gender can influence the academic performance of the student<sup>(34)</sup>. A previous study found that gender is an important factor that affect students' performance in introductory economics course in an university where male students 'academic performance was better than female<sup>(35)</sup>. Another study concludes that there was no significant evidence to support gender differences on students' performance<sup>(36)</sup>. The relationship between gender and the academic performance for students was discussed by many authors<sup>(37)</sup>. A previous study found a gap between the academic performance between male and female students found that female academic performance was better than male<sup>(38)</sup>. Another study viewed that gender was a significant contributor to the student academic performance<sup>(39,40)</sup>.

Considering all previous discussions, researchers conducted this study was made to examine the effect of different factors on the student's academic performance at the university level in Jeddah city of Saudi Arabia.

### 3 Methodology

Quantitative survey method was used in this study to explore the relationship between predefined factors. This methodology refers to an approach involving the use of numeric-based information that can be measured, compared, and analyzed statistically. This methodology is primarily used as a way to quantify achievement of outcomes as a result of participation in our study. The populations of our study are the **Saudi Arabia Universities**. After the identification of the objective of our research, we initiated the questionnaire writing process. Data were collected through a standardized instrument. Data are statistically analyzed and results are presented in a numerical format. The advantage of quantitative methodology is that it measures the reactions of great many students to a limited set of questions, thus facilitating comparison and aggregation of data.

The questionnaire includes the following variables: - gender, age, university name, mother's education, father's education, family size, quality of family relationships, friendship/peer relation and finally the last year scores.

Questionnaires were distributed among university students through online from Saudi Arabia Universities. The sample includes students who reflect the intended population in terms of all characteristics of the population (sex age, parents, level, grade. etc.).

### 4 Proposed approach

Questionnaire was established to include all the important factors that possibly influence students' performance in Saudi Arabia Universities. The questionnaire includes the following variables: - gender, age, university name, mother's education, father's education, family size, quality of family relationships, friendship/peer relation and finally last year scores. A statistical program SPSS platform version 25 was used to perform all statistical analysis required.

#### 4.1 Architecture

We adopt a three-tier architecture which is composed of three "tiers" or "layers" of logical computing. 3-tier architectures provide many benefits for production and development environments by modularizing the user interface, business logic, and data storage layers. The data tier stores information, the application tier handles logic and the presentation tier is a graphical user interface (GUI) that communicates with the other two tiers.

Presentation tier is built with HTML5, cascading style sheets (CSS) and, is deployed to a computing device through a web-based application.

The application tier, which may also be referred to as the logic tier, is written in Java language and contains the

business logic that supports the application’s core functions and the access to SPSS platform.

The data tier consists of a database and a program for managing read and write access to a database. This tier may also be referred to as the storage tier and has hosted on-premises.

The three-tier architecture design of our proposed solution is given in Figure 1 .

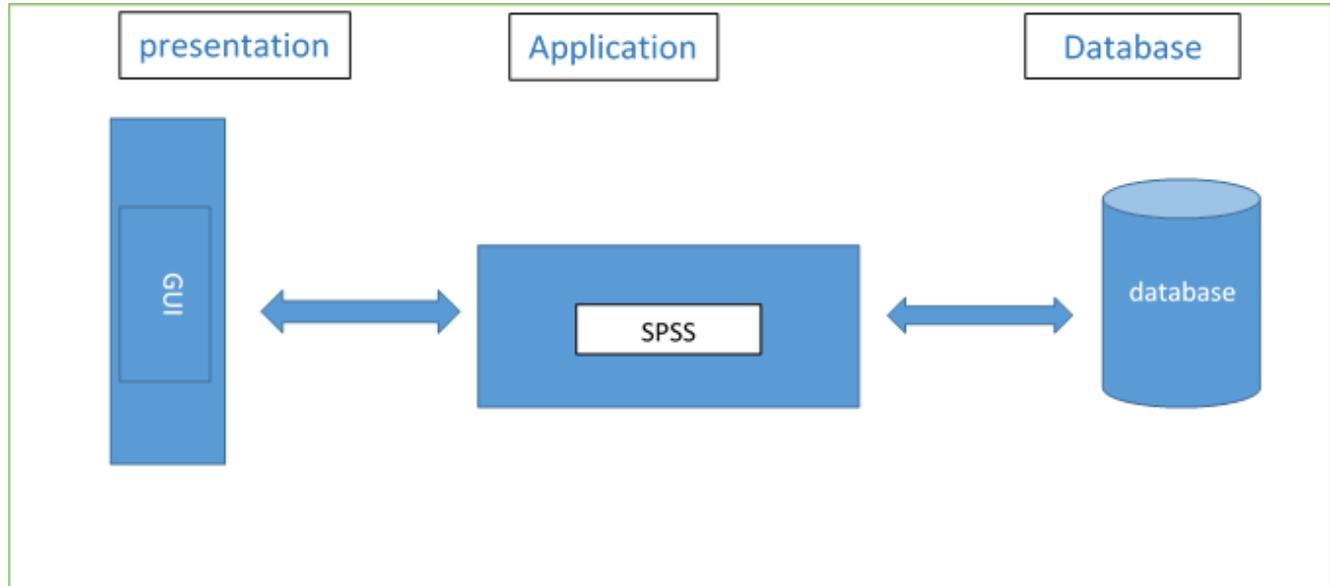


Fig 1. System architecture

### 4.2 Findings

Questionnaires were distributed among university students through online. The total responded students were 164. SPSS platform was used to perform all statistical analysis for this study.

Descriptive analysis showed that number of female participants was 127 and male was 37 with a percentage of 77.4% and 22.6% respectively. Table 1 showed male and females result study score distribution.

We are performing a correlational study of series of data in order to identify positive or negative correlations between different factors. Then our question is to specify which correlation coefficient is better to use?

We know that Pearson correlation coefficient is the most widely used. It measures the strength of the linear relationship between normally distributed variables. However, our variables are not normally distributed, then it may be more appropriate to use the Spearman rank correlation method.

Table 1. Male and female scores

Gender *		Score Last Year				Total
		2.0	2.1-3.0	3.1-4.0	4.1-5.0	
Gender	Male	4	7	13	13	37
	Female	0	6	36	85	127
Total		4	13	49	98	164

Correlation analysis between gender and scores using Spearman’s equation showed significant correlation between gender with P value < 0.01 and Spearman correlation coefficient (r) = 0.33 (see Table 2).

**Table 2.** Gender and scores relationship

Correlations			Score Last Year	Gender
Spearman's rho	Score Last Year	Correlation Coefficient	1.000	.325**
		Sig. (2-tailed)	.	.000
		N	164	164

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

The age group was divided into three groups. The group I age is from (17-20), group II is from (21-30) and group III from (31-42) year respectively with total number of participants 26, 129 and 9 respectively. It was found that group age (21-30) represent the highest percentage among all age groups (78.7%) followed by group age (17-20) with 15.9 % and age group (31-42) with 5.5% respectively.

For the first group, the high score (4.1-5.0) was at with 82 participants followed by age group (17-20) 13 participants and age group (31-42) with 3 participants respectively (see Table 3). No significant correlation between different age group and scores.

**Table 3.** Score distribution and age group

Age * Scores		Score Last Year				Total
Count		2.0	2.1-3.0	3.1-4.0	4.1-5.0	
		Age	17-20	1	3	
	21-30	3	5	39	82	129
	31-42	0	5	1	3	9
Total		4	13	49	98	164

The distribution of universities ‘participants from different universities were: Jeddah University (119), King Abdul-Aziz University (9), Battargee Medical College BMC (15), University of Technology (2) , Effat University (1), Suliman AL Rajhi College (1), Arab Open University (6), Taif University (1), Tabuk University(1), Taibah University (6), Jaizan University (1), Alghad College (1) and Hafar Albaten University (1) participant respectively.

Education of mother (see Table 4) was higher education in 76 cases, secondary education in 39 cases, primary education in 36 cases and finally 13 cases mothers without previous education.

**Table 4.** Mother’s education and students ‘scores

Mother’s education * Scores		Score Last Year				Total
		2.0	2.1-3.0	3.1-4.0	4.1-5.0	
		Education of Mother	No education	0	2	
	Primary Education	0	4	14	18	36
	Secondary Education	2	1	14	22	39
	Higher Education	2	6	15	53	76
Total		4	13	49	98	164

From Table 5, there was a significant correlation between mother’s education level (High education) and student scores with P value < 0.05 and Spearman correlation coefficient (r) = 0.18 (see Table 5). Hence, we demonstrate the impact of mother’s education on the associate children’s education.

**Table 5.** Mother’s education and students’ scores relationship

Correlations			Scores	Mother’s education
Spearman’s rho	Score Last Year	Correlation Coefficient	1.000	.184*
		Sig. (2-tailed)	.	.018
		N	164	164

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

Also, the effect of Education of father on student’s performance (scores) was studied. Father education level was as follow higher education in 112 cases, secondary 31 cases, primary 12 cases and 9 cases without education (see Table 6 ).

**Table 6.** Father’s education and students’ scores

Father education * Scores		Score Last Year				Total
		2.0	2.1-3.0	3.1-4.0	4.1-5.0	
Father’s education	No Education	0	1	4	4	9
	Primary Education	0	4	4	4	12
	Secondary Education	0	1	13	17	31
	Higher Education	4	7	28	73	112
Total		4	13	49	98	164

Correlation analysis between father’s education and scores using Spearman’s equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient (r) = 0.16 (see Table 7).

**Table 7.** Father’s education and students’ scores correlation analysis

Correlations			Scores	Father’s education
Spearman’s rho	Score Last Year	Correlation Coefficient	1.000	.162*
		Sig. (2-tailed)	.	.039
		N	164	164

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

Family size was studied in all cases. Family size in 84 cases were more than 3 individuals whilst, in 80 cases family size were less than 3 individuals. Family size and students’ scores was compared in Table 8. The high score (4.1-5.0) was found in 81 cases with more than 3 individuals’ families and in 17 cases for less than three individuals’ families

**Table 8.** Scores and family size

Family Size * Scores		Score Last Year				Total
		2.0	2.1-3.0	3.1-4.0	4.1-5.0	
Family Size	<=3	4	13	46	17	80
	>3	0	0	3	81	84
Total		4	13	49	98	164

Correlation analysis between family size and scores using Spearman’s equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient (r) = 0.75 (see Table 9).

Quality of family relation studied in 89 cases was excellent, in 44 cases was good, in 20 cases was moderate, in 6 cases was bad and in 5 cases was limited ( Table 10).

**Table 9.** Family size and scores correlation

Correlations			Scores	Family Size
Spearman's rho	Scores	Correlation Coefficient	1.000	.754**
		Sig. (2-tailed)	.	.000
		N	164	164

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

**Table 10.** Family relation and scores

Quality Family relation * Scores		Scores				Total
Quality family relation		2.0	2.1-3.0	3.1-4.0	4.1-5.0	
		Very Bad	0	0	0	
	Not Very Bad	0	0	0	5	5
	Middle	4	13	1	2	20
	Good	0	0	44	0	44
	Excellent	0	0	4	85	89
Total		4	13	49	98	164

Correlation analysis between family relation and scores using Spearman's equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient (r) = 0.68 ( Table 11).

**Table 11.** Family relation and scores relation

Correlations			Scores	Quality family relation
Spearman's rho	Scores	Correlation Coefficient	1.000	.682**
		Sig.(2-tailed)	.	.000
		N	164	164

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

The effect of friendship was studied (going with friends) and results showed that in 52 cases friendship was medium, in 46 cases was extremely low, in 29 cases were extremely high, in 26 cases was little and in 11 cases friendship was high. Correlation analysis showed significant correlation with P value < 0.05 and Spearman correlation coefficient (r) =0.80 (see Table 12).

**Table 12.** Scores and friend relationship

Correlations			Scores	Going with Friends
Spearman's rho	Scores	Correlation Coefficient	1.000	.808**
		Sig. (2-tailed)	.	.000
		N	164	164

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

## 5 Results and Discussion

Our results showed a significant correlation between gender and scores with P value < 0.01 and Spearman correlation coefficient (r) = 0.33 (see Table 2). Some authors suggested that gender has no effect on education<sup>(41)</sup>. Other studies suggested that gender is significant factor and female students show higher performance compared to male students

in addition to that females work harder and attend more frequently than males<sup>(42)</sup>. It has been suggested that gender was the only predictor of academic performance<sup>(43,44)</sup>. Another study on Pakistan found that female diploma nursing students in Pakistan are significantly better than males<sup>(45)</sup>. Our finding was same to those obtained by<sup>(42–45)</sup>. However, in our study female represent majority of cases (127 and male 37). One study was made on Nursing college at Hail city in Saudi Arabia conclude that gender had a significant effect on the performance (female students better than males) and other factors such as type of school, age, year level, marital status, and socio-economic status had no significant on the academic performance<sup>(46)</sup>. However, some authors argued that there was no correlation between gender and academic performance<sup>(47–49)</sup>. Another study on student performance suggested that performance can be enhanced through providing adequate learning resources for both the educator and student in addition; parent need to support their children with books and study materials and finally the rewarding system for education must be improved to motivate teachers and educators for learning process<sup>(50)</sup>.

There was a significant correlation between mother and father education level (High education) and student scores. Our results showed significant correlation between mother education and scores using with P value < 0.05 and Spearman correlation coefficient ( $r$ ) = 0.18. Correlation analysis between father education and scores showed significant correlation with P value < 0.05 and Spearman correlation coefficient ( $r$ ) = 0.16. These results indicate that parent education is an important factor for student performance. Our finding was same to those obtained by<sup>(51)</sup>.

Family relation showed a positive impact on student performance in our study. Family relation and scores using Spearman's equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient ( $r$ ) = 0.68. A previous study showed that family relation and its different dimensions were the significant predictors of students' academic performance<sup>(52)</sup>.

Family size has a positive impact on the student performance. Correlation analysis between family size and scores using Spearman's equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient ( $r$ ) = 0.75. However, this result was opposite to those found by previous study<sup>(53)</sup>. It was suggested family size have a negative impact on student performance in poor environment due to lack of quality feeding, lack of proper medical care, and more so a child will not be given the required attention for his study<sup>(53)</sup>. Family size not always have a negative impact on student education because the older son can teach the young one and education may transfer from old brother to young brother and so on. A previous study in Nigeria showed a significant correlation between family size and student education<sup>(54)</sup>.

Correlation analysis between friend relationship and scores using Spearman's equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient ( $r$ ) = 0.80. A previous study suggested that high-achieving students are more likely to extend ties to other high-achieving students, net of other socio demographic, network, and proximity characteristics, while low-achieving students are more likely to extend ties to other low-achieving students<sup>(55)</sup>. This may give an idea that students tend to go with those have the same attitude and targets.

## 6 Conclusion

Many authors indicated different factors influence the student education. It was suggested that higher socio-economic status (SES) becomes a significant predictor for students' performance at school besides the other school factors, peer factors and student factors<sup>(4)</sup>. Another study suggested that there are three factors affect student performance; those are: parents, teachers, and students<sup>(56)</sup>. We are proposed three-tier architecture to enable us to make better decisions faster by analyzing different data sources that are centralized and stored on different types of servers.

Our results showed a significant correlation between genders and scores with P value < 0.01 and Spearman correlation coefficient ( $r$ ) = 0.33. Also, Correlation analysis between friend relationship and scores using Spearman's equation showed significant correlation with P value < 0.05 and Spearman correlation coefficient ( $r$ ) = 0.80. Hence, many factors can impact can affect students' performance such as parents, teachers, fellow students, and society. The major problem is to find the best correlation between different factors that can impact students' results.

The principle limitation of our method is the sample size. Therefore, we must consider larger dataset and use more

specific analysis.

We provide suggestions of several possible future research directions:

First, we hope to further investigate the possibility to use unsupervised machine learning solution in order to improve the correlations between different studied factors and examine our approach in another way. We are also looking at using larger students' contextual datasets in addition to evaluating our proposals.

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