International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

EFFECT OF THE DEMOGRAPHIC CHARACTERISTICS ON STUDENTS' ACHIEVEMENT- A PATH ANALYTIC STUDY*

Assist.Prof.Dr. Serhat KOCAKAYA
Yüzüncü Yıl University,Van- TURKEY

Assoc.Prof.Dr. Selahattin GÖNEN
Dicle University, Diyarbakir-TURKEY

ABSTRACT

Primary purpose of this study is to examine the influence of the demographic characteristics and the relationships between these characteristics on the students' achievement with path analysis. First of all the affects of the demographic characteristics to the elementary school diploma grades of the students and later the affects of the elementary school diploma grade together with the demographic characteristics have been examined. In the result of the examinations made with the path analysis; while its being determined that the education level of the father and gender variables among the demographic characteristics did not have an affect over the physics achievement that the students achieved from this study however the education level of the mother and the income level of the family had a positive effect on the elementary school achievement grades of the student.

Key Words: Physics education, path analysis, demographic characteristics, achievement.

INTRODUCTION

Studies have conducted regarding to the achievement reveal that the families' education levels are an important factor in estimating the students' achievement (Klebanoy, Brooks- Gunn, & Duncan, 1994; Haveman & Wolfe, 1995; Smith, Brooks-Gunn, & Lebanov, 1997). Certain studies that have been done on this subject reveal that the families' education levels affect in positive direction both their behaviors and beliefs towards raising their children (Eccles, 1993) and children' achievements and learning experiences (Jimerson, Egeland, & Teo, 1999; Kohn, 1963; Luster, Rhoades, & Haas, 1989). It has been also determined by Alexander, Entwisle, and Bedinger (1994) that the families with higher education and income levels have been paying more attention to daily performances of their children in comparison with the families with lower education and income levels. Along with that, Halle and friends (1997) have determined that as the mother's education level increasing with expectations of the children regarding academic achievement also increases and further determined that this has been as much influential as perceptions that the children have had and as a result of this, the children' achievements have increased in mathematics and reading lessons, in a study they have performed over low income families. Certain researchers have stated that the families' education level's increase, especially of the mother, forms a warmer social environment in home atmosphere and both the mother's education level and income level has a significant effect on the learning activities' determination at home and in physical environments; however, warm relationship between the families and children on the other hand is only provided by the mother (Klebanov et al. 1994). In a similar form, Smith and friends (1997) have indicated that increase in the student achievement that is connected to the family's income level and the

* This study had been derived from Kocakaya (2008)'s Ph.D. thesis and had been funded by Dicle University Scientific Research Project (DÜBAP-06-EF-86).

families' education is influenced by the home environment and the mother's involvement in this achievement that the students reveal on the other hand is more effective than the income level. Another factor stated to be effective in the student's achievement that the families' education levels and, which is also main foundation in the constructive learning, is an initial knowledge that the students have had. The factors such as age, gender, and Department's line of preference that he/she studies, working part-time or full-time at a workplace, attitude and self-efficacy that has an effect on the student's achievement have been examined with the path analysis in a study conducted by Zeegers (2004) concerning this subject. For that purpose, a study has been conducted by working with two groups of students, who have been receiving an education in the science department of Flinders University and 194 of these students are freshmen and 118 of them are sophomore. And, it has been determined as a result of the study that the achievement coming from the students' previous education has increased their achievements and learning English abilities in the university.

The gender factor's effectiveness that remains outside of the families' education levels and initial knowledge that the students have been also examined in this study due to the fact that whether or not the gender factor have had any effects over the students' achievement or topic of many studies (Zeeger, 2004; Jones, Howe & Rua, 2000). As it has been informed about the gender factor having an effect on the student's achievement in the studies conducted over the gender factor (Lietz, 1996), it is also being informed that the gender factor does not have a significant effect over the students' achievement (Kocakaya, 2008; Zeegers, 2004; Murray-Harvey 1993).

The path analysis technique, which is an application field of structural equation model, has been used while the demographic characteristics' influences discussed on the students' physics achievement are being examined in this study's scope. Since it is necessary to tackle both observable and unobservable impacts to be able to make healthier comments in the path analysis, interaction between the variables has been examined by considering both the observable and unobservable (IE, UE, SE) effects in this study and this is what makes this research different from the similar researches.

Problem status

While the student achievement is being measured in field education studies, results and comments, which are going to be achieved with considering the demographic characteristics' effects and unobservable effects, that these characteristics have achieved over one another are going to contribute for us to present more permanent solutions instead of using only a single variable (for example: teaching method).

Aim

The primary aim of this study is to examine the factors that affect the student achievement with the path analysis technique by not only on the basis of teaching method but also considering the other factors (The mother's education level, family's income level, gender, the father's education level and elementary school diploma grade) at the same time.

METHOD

Population and Sample

High school students who are taking physics course in the city center of the province of Diyarbakir/Turkey in the academic year of 2006-2007 form the population of this study and 167 students taking physics course in schools where the application is performed in the scope of the study form the sample of this study.

Application Process

Study has been conducted for the duration of 4 weeks (8 hours) over the 167 students who are taking physics course in the 2nd and 3rd grade of four different high schools found in the city center of the province of Diyarbakir/Turkey in the academic year of 2006-2007. In the scope of the study, the school in which the study is going to be executed determined in the form of one science high school (takes students with central exam), one anatolian high school (takes students with central exam), one vocational high school and one public high school. Two groups have been formed in each of the schools determined. An electrostatic achievement test (developed by authors) made of 30 multiple choice questions and a demographic characteristics' survey has been formed 8 questions that have been applied to the each group formed. The analyses performed however, have been done by only considering 5 of the demographic characteristics in this study. Random selection has been made about which the instruction method would be applied on which group. The instruction method to one of the students' group has been applied according to Computer Aided Cooperative Learning (CACL) model and the other student group has been applied according to Computer Aided 7E (CA7E) model.

Data in this study conducted has been analyzed by using package program of SPSS 15.0 and Amos 7.0. Path coefficients (standardized regression coefficients) of the values obtained as the result of the analysis performed with the package program of SPSS 15.0 and Amos 7.0 have been shown directly on the path diagram and only the correlation coefficients and results of path analysis have been shown in form of tables.

Interactions Seen Between the Variables and Variables Types

There are four different effects among the variables that have been subjected to the path analysis and these are indicated as observable (direct) effect (DE), unobservable (indirect) effect (IE), Unanalyzed effect (U), and Spurious effect (S). [Please look at the Kocakaya (2008) to more detailed explanations of those effects]

Interpretation and Analysis of the Data

The data obtained from this study have been tackled on the basis of two learning approaches (CACL and CA7E) and two different path analyses have been performed for the examining the effects of demographic characteristics for the student achievement. Therefore, besides the demographic characteristics' effect, the effectiveness level of the teaching approaches has also been researched.

In the path analysis, in order to the relationships to be fully analyzed; it is necessary to keep in mind all the reason variables and result variables and all the relationships of the reason variables among themselves and even the existence of a significant relationship between the variables have to be shown on path diagram. In order to the interpretation of all conditions creating difference on the result variables and rising from the applied learning approaches together with the demographic characteristics and the statistical results as a whole here a different method named "Consistency Coefficient [$T(X_m:Y_n)$]" has been suggested and a different route of evaluation has been taken. The fundamental steps of this evaluation method which has been suggested by Kocakaya (2008) are as follow:

1. Consistencies in the relationships that the same variables had with one another in each of the two teaching methods have been considered (For example: the gender variable in the CACL and CA7E.).
2. If the relationship between two of the same variables analyzed in each two of the learning approaches and result variable is statistically significant, the consistency coefficient has been accepted as "1".
3. If the relationship between the result variable and only one of two of the same variables analyzed in each two of the learning approaches is statistically significant, the consistency coefficient has been accepted as "0.5".
4. If there is no statistical significance between the result variable and the two of the same variables analyzed in each two of the learning approaches, the consistency coefficient has been accepted as "0".
5. The variables effect with the consistency coefficient of "1" on the result variable has been accepted as directly significant.
6. The variables with the consistency coefficient of "0.5" have been interpreted by looking at the percentage in the total effect of the DE effects of their both.
7. The variables with the consistency coefficient of "0" have been accepted as having no effect on the result variable.

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

[$T(X_m:Y_n)$; m, n=1, 2, 3….]: has been defined as the consistency coefficient between the X reason variable and Y result variable.

FINDINGS

In this section, at first stage, the parent's education levels effects, gender and the family income status to the student's elementary school diploma grade have been analyzed with the approaches of CACL and CA7E. In the second stage on the other hand, the parent's education levels' effects, gender, family income status and the student's elementary school diploma grade onto the achievements connected to the subject of the student's electrostatic has been analyzed.

At the end of the study, it has been determined from the results obtained from the t-tests of the groups that have been coupled in order to determine the learning approach's effect on the student achievement; both CACL (t=6,172 and P<0.001) and CA7E (t=6,852 and P<0.001) contributed positively and significantly to the students' achievement. Also, the demographic characteristics' analysis remain outside of the learning approaches in the achievement that the student shown on the other hand has been performed with the path analysis. The path diagram showing the relationships between the variables used during the analysis of the data has been given in Figure 1. P_{XY} among the symbols taking place in the Figure 1 shows the path coefficient between the variables and r_{xy} on the other hand shows the correlation coefficient between the variables.

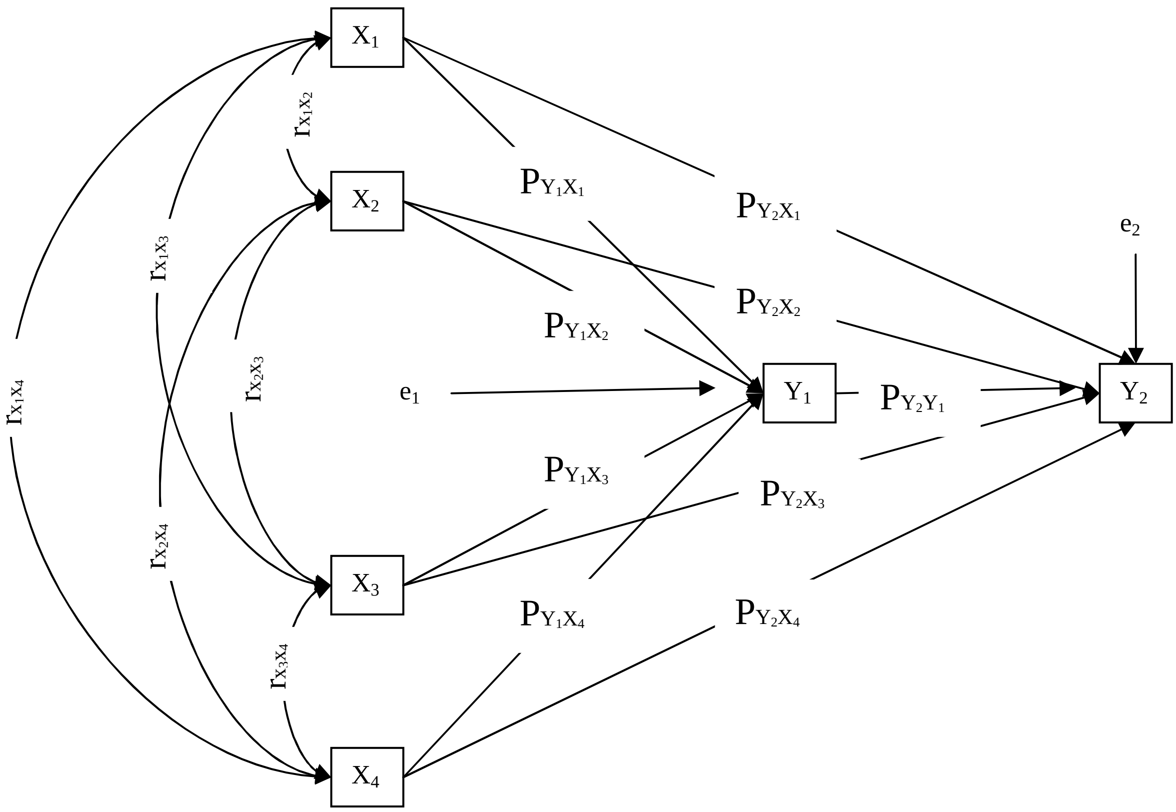

Figure 1 : Path Diagram Showing the Relationships between the Variables

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

X_1: Mother's education level, X_2: Family's income level, X_3: Gender, X_4: Father's education level, Y_1: Elementary school diploma grade, Y_2: Score obtained from the achievement test, e_1 and e_2: Unobservable external variables.

At the end of the regression analysis performed the path coefficients (standardized regression coefficients) between all the variables have been shown in the diagram in Figure 2. The values on the arrows located in the diagram; the ones on the left side shows the path coefficients obtained from the data of the students that taken physics course with CACL and the ones on the right side shows the path coefficients obtained from the data of the students taken physics course with CA7E (For example; such as 111 & 222).

Since the main purpose of the path analysis is to separate the components of the correlation between the variables, it is necessary for us to know the correlation coefficient between all the variable pairs. Correlation coefficients between all the variables inside the study have been given in Table 1. In the correlation coefficients found in Table 1 there are 2 columns for each variable. Left column shows the correlation coefficients found according to the data of the students taken physics course with CACL and right column shown the correlation coefficient obtained from the data of the students taken physics course with CA7E.

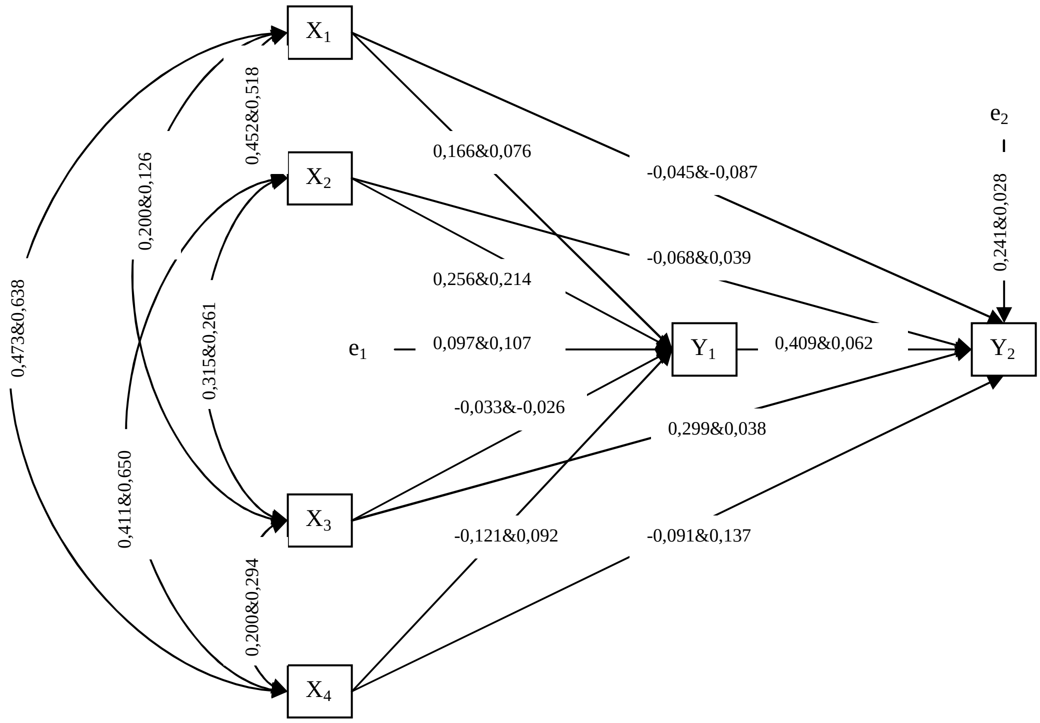

Figure 2: Path Diagram and Coefficients of the Model Established for the CACL & CA7E Approaches.

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

Table 1: Correlation Matrix

Variables		X_1		X_2		X_3		X_4		Y_1		Y_2	
		CACL	CA7E	CACL	CA7E	CACL	CA7E	CACL	CA7E	CACL	CA7E	CACL	CA7E
X_1	Pearson Corr.	1	1										
	Sig. (2-tailed)												
	N	90	77										
X_2	Pearson Corr.	,452**	,518**	1	1								
	Sig. (2-tailed)	,001	,001										
	N	90	77	90	77								
X_3	Pearson Corr.	,200	,126	,315**	,261*	1	1						
	Sig. (2-tailed)	,058	,274	,003	,022								
	N	90	77	90	77	90	77						
X_4	Pearson Corr.	,473**	,638**	,411**	,650**	,199	,294**	1	1				
	Sig. (2-tailed)	,001	,001	,001	,001	,060	,009						
	N	90	77	90	77	90	77	90	77				
Y_1	Pearson Corr.	,217*	,242*	,271**	,306**	,057	,066	,056	,271*	1	1		
	Sig. (2-tailed)	,040	,034	,010	,007	,595	,569	,602	,017				
	N	90	77	90	77	90	77	90	77	90	77		
Y_2	Pearson Corr.	,030	,040	,079	,111	,273**	,081	-,058	,134	,393**	,093	1	1
	Sig. (2-tailed)	,779	,729	,462	,335	,009	,483	,585	,244	,001	,423		
	N	90	77	90	77	90	77	90	77	90	77	90	77

*P<0.05, **P<0.01

Separation of the Correlations between the Demographic Variables Affecting the Physics Achievement into Components in the Path Model Established for the CACL Approach

In this section, analyses related to demographic characteristics which affect achievement of students' physics achievement have been given.

Analyses Concerning with the Effects of the Demographic Characteristics to the Achievement in the CACL Approach

When the correlations between the variables are separated into components and if the correlation between the X_1 and Y_1 **(** $r_{y_1x_1}$) is written by separating the components as it is seen below [for detailed explanation about constructing determinant and linear equations please look at Kocakaya (2008)],

$$r_{y_2x_1} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_1} \\ r_{x_2x_1} \\ r_{x_3x_1} \\ r_{x_4x_1} \\ r_{y_1x_1} \end{bmatrix} \tag{1}$$

$$r_{y_2x_1} = P_{Y_2X_1} r_{x_1x_1} + P_{Y_2X_2} r_{x_2x_1} + P_{Y_2X_3} r_{x_3x_1} + P_{Y_2X_4} r_{x_4x_1} + P_{Y_2Y_1} r_{y_1x_1} \tag{2}$$

It is found such as shown.

In order to this expression to be written in a clear form, it is necessary to state the expansions of the $r_{x_1x_1}$, $r_{x_2x_1}$, $r_{x_3x_1}$, $r_{x_4x_1}$ and $r_{y_1x_1}$. Since the $r_{x_1x_1}$, $r_{x_2x_1}$, $r_{x_3x_1}$, and $r_{x_4x_1}$ are the correlations between the exogenous variables, their values given in the Table 1 is used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for $r_{y_1x_1}$ to be turned into the matrix form as it is in $r_{y_2x_1}$. When the $r_{y_1x_1}$ is written in the matrix form and the necessary operations are performed $r_{y_1x_1}$,

($r_{x_1x_2}=r_{x_2x_1}$, $r_{x_1x_3}=r_{x_3x_1}$, $r_{x_1x_4}=r_{x_4x_1}$, $r_{x_2x_3}=r_{x_3x_2}$, $r_{x_2x_4}=r_{x_4x_2}$, $r_{x_3x_4}=r_{x_4x_3}$, $r_{y_1x_1}=r_{x_1y_1}$, $r_{y_1x_2}=r_{x_2y_1}$, $r_{y_1x_3}=r_{x_3y_1}$, $r_{y_1x_4}=r_{x_4y_1}$, $r_{y_2x_1}=r_{x_1y_2}$, $r_{y_2x_2}=r_{x_2y_2}$, $r_{y_2x_3}=r_{x_3y_2}$, $r_{y_2x_4}=r_{x_4y_2}$)

$$r_{y_1x_1}=\left[P_{Y_1X_1}P_{Y_1X_2}P_{Y_1X_3}P_{Y_1X_4}\right]\begin{bmatrix} r_{x_1x_1} \\ r_{x_2x_1} \\ r_{x_3x_1} \\ r_{x_4x_1} \end{bmatrix} \tag{3}$$

$$r_{y_1x_1}=P_{Y_1X_1}r_{X_1X_1}+P_{Y_1X_2}r_{X_2X_1}+P_{Y_1X_3}r_{x_3x_1}+P_{Y_1X_4}r_{x_4x_1} \tag{4}$$

it is found such as this.

When the correlation between the X_1 and Y_2 is separated into its components,

$$r_{y_2x_1}=P_{Y_2X_1}r_{x_1x_1}+P_{Y_2X_2}r_{x_2x_1}+P_{Y_2X_3}r_{x_3x_1}+P_{Y_2X_4}r_{x_4x_1}+P_{Y_2Y_1}(P_{Y_1X_1}r_{x_1x_1}+P_{Y_1X_2}r_{x_2x_1}+P_{Y_1X_3}r_{x_3x_1}+P_{Y_1X_4}r_{x_4x_1}) \tag{5}$$

$$r_{y_2x_1}=P_{Y_2X_1}r_{x_1x_1}+P_{Y_2X_2}r_{x_2x_1}+P_{Y_2X_3}r_{x_3x_1}+P_{Y_2X_4}r_{x_4x_1}+P_{Y_2Y_1}P_{Y_1X_1}r_{x_1x_1}+P_{Y_2Y_1}P_{Y_1X_2}r_{x_2x_1}+P_{Y_2Y_1}P_{Y_1X_3}r_{x_3x_1}+P_{Y_2Y_1}P_{Y_1X_4}r_{x_4x_1} \tag{6}$$

$$r_{y_2x_1}=0{,}030 \tag{7}$$

It is found as shown.

In the analysis above, all the effects of the X_1 over the Y_2 has been shown in Table 2.

Table 2: DE, IE, S and U Effects of the Mother's Education Level the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1}r_{x_1x_1}$	DE	-0,045	-149
$P_{Y_2X_2}r_{x_2x_1}$	U	- 0,031	-102
$P_{Y_2X_3}r_{x_3x_1}$	U	0,060	198
$P_{Y_2X_4}r_{x_4x_1}$	U	- 0,043	-143
$P_{Y_2Y_1}P_{Y_1X_1}r_{x_1x_1}$	IE	0,068	225
$P_{Y_2Y_1}P_{Y_1X_2}r_{x_2x_1}$	U	0,047	157
$P_{Y_2Y_1}P_{Y_1X_3}r_{x_3x_1}$	U	-0,003	-9
$P_{Y_2Y_1}P_{Y_1X_4}r_{x_4x_1}$	U	-0,023	-77
Total	$r_{y_2x_1}$	0,030	100

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

When the correlation between the X_1 and Y_1 is separated into its components as it is seen below,

$$r_{y_1x_1} = P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1} \quad (8)$$

$$r_{y_1x_1} = 0{,}217 \quad (9)$$

It is found as this.

In the analysis above, all effects of the X_1 on Y_1 has been shown in Table 3.

Table 3: DE, IE, S and U Effects of the Mother's Education Level on the Elementary School Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1} r_{x_1x_1}$	DE	0,166	76
$P_{Y_1X_2} r_{x_2x_1}$	U	0,115	53
$P_{Y_1X_3} r_{x_3x_1}$	U	– 0,007	-3
$P_{Y_1X_4} r_{x_4x_1}$	U	– 0,057	-26
Total	$r_{y_1x_1}$	0,217	100

Correlation between X_2 and Y_2, ($r_{y_2x_2}$), is separated into its components in the form shown below.

When the ($r_{y_2x_2}$) is written as below,

$$r_{y_2x_2} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1} \right] \begin{bmatrix} r_{x_1x_2} \\ r_{x_2x_2} \\ r_{x_3x_2} \\ r_{x_4x_2} \\ r_{y_1x_2} \end{bmatrix} \quad (10)$$

$$r_{y_2x_2} = P_{Y_2X_1} r_{x_1x_2} + P_{Y_2X_2} r_{x_2x_2} + P_{Y_2X_3} r_{x_3x_2} + P_{Y_2X_4} r_{x_4x_2} + P_{Y_2Y_1} r_{y_1x_2} \quad (11)$$

It is found as expressed above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of $r_{x_1x_2}$, $r_{x_2x_2}$, $r_{x_3x_2}$, $r_{x_4x_2}$, and $r_{y_1x_2}$. Since the $r_{x_1x_2}$, $r_{x_2x_2}$, $r_{x_3x_2}$, and $r_{x_4x_2}$ are the correlations between the exogenous variables the values given in the Table 1 for them are used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for $r_{y_1x_2}$ to be turned into the matrix form as it is in $r_{y_2x_2}$. When the $r_{y_1x_2}$ is written in the matrix form and the necessary operations are performed $r_{y_1x_2}$,

$$r_{y_1x_2} = \left[P_{Y_1X_1} P_{Y_1X_2} P_{Y_1X_3} P_{Y_1X_4} \right] \begin{bmatrix} r_{x_1x_2} \\ r_{x_2x_2} \\ r_{x_3x_2} \\ r_{x_4x_2} \end{bmatrix} \quad (12)$$

$$r_{y_1x_2} = P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{X_2X_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2} \quad (13)$$

is found as it is shown above.

When the X_2 and Y_2 are separated into their components,

$$r_{y_2x_2} = P_{Y_2X_1} r_{x_1x_2} + P_{Y_2X_2} r_{x_2x_2} + P_{Y_2X_3} r_{x_3x_2} + P_{Y_2X_4} r_{x_4x_2} + P_{Y_2Y_1}(P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{X_2X_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2}) \quad (14)$$

$$r_{y_2x_2} = P_{Y_2X_1} r_{x_1x_2} + P_{Y_2X_2} r_{x_2x_2} + P_{Y_2X_3} r_{x_3x_2} + P_{Y_2X_4} r_{x_4x_2} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_2} + P_{Y_2Y_1} P_{Y_1X_2} r_{X_2X_2} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_2} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_2} \quad (15)$$

$$r_{y_2x_2} = 0{,}079 \quad (16)$$

found as it is shown above.

All effects of the X_2 on Y_2 are shown in the Table 4.

Table 4: DE, IE, S and U Effects of the Family's Income Level on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1} r_{x_1x_2}$	U	-0,02	-25
$P_{Y_2X_2} r_{x_2x_2}$	DE	-0,068	-86
$P_{Y_2X_3} r_{x_3x_2}$	U	0,094	118
$P_{Y_2X_4} r_{x_4x_2}$	U	- 0,037	-47
$P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_2}$	U	0,030	38
$P_{Y_2Y_1} P_{Y_1X_2} r_{x_2x_2}$	IE	0,104	132
$P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_2}$	U	-0,004	-05
$P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_2}$	U	-0,02	-25
Total	$r_{y_2x_2}$	0,079	100

When the correlation between the X_2 and Y_1 is separated into its components,

$$r_{y_1x_2} = P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{x_2x_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2} \quad (17)$$

$$r_{y_1x_2} = 0{,}271 \quad (18)$$

is found as it is shown above.

In the analysis above, all effects of the X_2 on the Y_1 is shown in Table 5.

Table 5: DE, IE, S and U Effects of the Family's Income Level on the Elementary School Diploma Grade.

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1} r_{x_1x_2}$	U	0,075	27
$P_{Y_1X_2} r_{x_2x_2}$	DE	0,256	94
$P_{Y_1X_3} r_{x_3x_2}$	U	– 0,010	-3
$P_{Y_1X_4} r_{x_4x_2}$	U	– 0,050	-18
Total	$r_{y_1x_2}$	0,271	100

Correlation ($r_{y_2x_3}$) between the X_3 and the Y_2 is separated into its components as it is shown below.

When the ($r_{y_2x_3}$) is written as below,

$$r_{y_2x_3} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_3} \\ r_{x_2x_3} \\ r_{x_3x_3} \\ r_{x_4x_3} \\ r_{y_1x_3} \end{bmatrix} \quad (19)$$

$$r_{y_2x_3} = P_{Y_2X_1} r_{x_1x_3} + P_{Y_2X_2} r_{x_2x_3} + P_{Y_2X_3} r_{x_3x_3} + P_{Y_2X_4} r_{x_4x_3} + P_{Y_2Y_1} r_{y_1x_3} \quad (20)$$

It is found as is it shown above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of $r_{x_1x_3}$, $r_{x_2x_3}$, $r_{x_3x_3}$, $r_{x_4x_3}$, and $r_{y_1x_3}$. Since the $r_{x_1x_3}$, $r_{x_2x_3}$, $r_{x_3x_3}$, and $r_{x_4x_3}$ are the correlations between the exogenous variables, the values given in the Table 1 for them are used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for $r_{y_1x_3}$ to be turned into the matrix form as it is in $r_{y_2x_3}$.

When the ry_1x_3 is written in the matrix form and the necessary operations are performed $r_{y_1x_3}$,

$$r_{y_1x_3} = \left[P_{Y_1X_1} P_{Y_1X_2} P_{Y_1X_3} P_{Y_1X_4}\right] \begin{bmatrix} r_{x_1x_3} \\ r_{x_2x_3} \\ r_{x_3x_3} \\ r_{x_4x_3} \end{bmatrix} \quad (21)$$

$$r_{y_1x_3} = P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3} \quad (22)$$

found as it is shown above.

When the correlation between the X_3 and the Y_2 is separated into its components,

$$r_{y_2x_3} = P_{Y_2X_1} r_{x_1x_3} + P_{Y_2X_2} r_{x_2x_3} + P_{Y_2X_3} r_{x_3x_3} + P_{Y_2X_4} r_{x_4x_3} + P_{Y_2Y_1} (P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3}) \quad (23)$$

$$r_{y_2x_3} = P_{Y_2X_1} r_{x_1x_3} + P_{Y_2X_2} r_{x_2x_3} + P_{Y_2X_3} r_{x_3x_3} + P_{Y_2X_4} r_{x_4x_3} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_3} + P_{Y_2Y_1} P_{Y_1X_2} r_{X_2X_3} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_3} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_3} \quad (24)$$

$$r_{y_2x_3} = 0,273681 \quad (25)$$

It is found as it is expressed above.

All effects of the X_3 on the Y_2 have been shown in the Table 6.

Table 6: DE, IE, S and U Effects of the Gender on the Achievement Test.

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1} r_{x_1x_3}$	U	-0,009	-3
$P_{Y_2X_2} r_{x_2x_3}$	U	- 0,02142	-8
$P_{Y_2X_3} r_{x_3x_3}$	DE	0,299	109
$P_{Y_2X_4} r_{x_4x_3}$	U	- 0,01811	-7
$P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_3}$	U	0,013579	5
$P_{Y_2Y_1} P_{Y_1X_2} r_{x_2x_3}$	U	0,032982	12
$P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_3}$	IE	-0,0135	-5
$P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_3}$	U	-0,00985	-3
Total	$r_{y_2x_3}$	0,273681	100

When the correlation between X_3 and Y_1 is separated into its components,

$$r_{y_1x_3} = P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3} \quad (26)$$

$$r_{y_1x_3} = 0{,}057 \quad (27)$$

It is found as it is shown above.

All effects of the X_3 on Y_1 have been shown in the Table 7.

Table 7: DE, IE, S and U Effects of the Gender on the Elementary School Diploma Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1} r_{x_1x_3}$	U	0,033	58
$P_{Y_1X_2} r_{x_2x_3}$	U	0,081	142
$P_{Y_1X_3} r_{x_3x_3}$	DE	– 0,033	-58
$P_{Y_1X_4} r_{x_4x_3}$	U	– 0,024	-42
Total	$r_{y_1x_3}$	0,057	100

Correlation ($r_{y_2x_4}$) between the X_4 and Y_2 is separated into its components as it is shown below.

When $r_{y_2x_4}$ is written as below,

$$r_{y_2x_4} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_4} \\ r_{x_2x_4} \\ r_{x_3x_4} \\ r_{x_4x_4} \\ r_{y_1x_4} \end{bmatrix} \quad (28)$$

$$r_{y_2x_4} = P_{Y_2X_1} r_{x_1x_4} + P_{Y_2X_2} r_{x_2x_4} + P_{Y_2X_3} r_{x_3x_4} + P_{Y_2X_4} r_{x_4x_4} + P_{Y_2Y_1} r_{y_1x_4} \quad (29)$$

It is found as it is expressed above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of the $r_{x_1x_4}$, $r_{x_2x_4}$, $r_{x_3x_4}$, $r_{x_4x_4}$, and $r_{y_1x_4}$. Since the $r_{x_1x_4}$, $r_{x_2x_4}$, $r_{x_3x_4}$, and $r_{x_4x_4}$ are the correlations between the exogenous variables, their values given in the Table 1 is used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for ry_1x_4 to be turned into the matrix form as it is in $r_{y_2x_4}$. When the $r_{y_1x_4}$ is written in the matrix form and the necessary operations are performed $r_{y_1x_4}$,

$$r_{y_1x_4} = \left[P_{Y_1X_1} P_{Y_1X_2} P_{Y_1X_3} P_{Y_1X_4}\right] \begin{bmatrix} r_{x_1x_4} \\ r_{x_2x_4} \\ r_{x_3x_4} \\ r_{x_4x_4} \end{bmatrix} \quad (30)$$

$$r_{y_1x_4} = P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4} \quad (31)$$

found as it is shown above.

When the correlation between the X_4 and Y_2 is separated into its components,

$$r_{y_2x_4} = P_{Y_2X_1} r_{x_1x_4} + P_{Y_2X_2} r_{x_2x_4} + P_{Y_2X_3} r_{x_3x_4} + P_{Y_2X_4} r_{x_4x_4} + P_{Y_2Y_1}(P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4}) \quad (32)$$

$$r_{y_2x_4} = P_{Y_2X_1} r_{x_1x_4} + P_{Y_2X_2} r_{x_2x_4} + P_{Y_2X_3} r_{x_3x_4} + P_{Y_2X_4} r_{x_4x_4} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_4} + P_{Y_2Y_1} P_{Y_1X_2} r_{X_2X_4} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_4} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_4} \quad (33)$$

$$r_{y_2x_4} = -0{,}058 \quad (34)$$

found as it is expressed above.

All effects of the X_4 on Y_2 have been shown in the Table 8 in the analysis above.

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

Table 8: DE, IE, S and U Effects of the Father's Education Level on the Achievement Test.

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1} r_{x_1x_4}$	U	-0,021	37
$P_{Y_2X_2} r_{x_2x_4}$	U	- 0,028	48
$P_{Y_2X_3} r_{x_3x_4}$	U	0,059	-103
$P_{Y_2X_4} r_{x_4x_4}$	DE	- 0,091	157
$P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_4}$	U	0,032	-55
$P_{Y_2Y_1} P_{Y_1X_2} r_{x_2x_4}$	U	0,043	-74
$P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_4}$	U	-0,003	4
$P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_4}$	IE	-0,049	86
Total	$r_{y_2x_4}$	-0,058	100

When the correlation between the X_4 and Y_1 is separated into its components as below,

$$r_{y_1x_4} = P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4} \quad (35)$$

$$r_{y_1x_4} = 0{,}056 \quad (36)$$

$r_{y_1x_4}$ is found as it is shown above.

All effects of the X_4 on Y_1 in the above analysis have been shown in Table 9.

Table 9: DE, IE, S and U Effects of the Father's Education Level on the Elementary School Diploma Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1} r_{x_1x_4}$	U	0,078	139
$P_{Y_1X_2} r_{x_2x_4}$	U	0,105	187
$P_{Y_1X_3} r_{x_3x_4}$	U	– 0,006	-11
$P_{Y_1X_4} r_{x_4x_4}$	DE	– 0,121	-215
Total	$r_{y_1x_4}$	0,056	100

Correlation ($r_{y_2y_1}$) between the Y_1 and Y_2 is separated into its components as it is shown below.

When the ($r_{y_2y_1}$) is in the way as it is below,

$$r_{y_2y_1} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1y_1} \\ r_{x_2y_1} \\ r_{x_3y_1} \\ r_{x_4y_1} \\ r_{y_1y_1} \end{bmatrix} \tag{37}$$

$$r_{y_2y_1} = P_{Y_2X_1} r_{x_1y_1} + P_{Y_2X_2} r_{x_2y_1} + P_{Y_2X_3} r_{x_3y_1} + P_{Y_2X_4} r_{x_4y_1} + P_{Y_2Y_1} r_{y_1y_1} \tag{38}$$

($r_{y_2y_1}$) is found as it is stated above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of $r_{y_1x_1}$, $r_{y_1x_2}$, $r_{y_1x_3}$, $r_{y_1x_4}$, and $r_{y_1y_1}$. Since the $r_{y_1x_1}$, $r_{y_1x_2}$, $r_{y_1x_3}$, and $r_{y_1x_4}$ have been found as [(4), (13), (22) and (31)] in the previous operations and written in matrix form. For this reason there was no need for repeating these matrixes and directly written in places of their open forms below.

$$r_{y_1x_1} = P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1}$$
$$r_{y_1x_2} = P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{x_2x_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2}$$
$$r_{y_1x_3} = P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3}$$
$$r_{y_1x_4} = P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4}$$

If these equations are written where they belong in the (38),

$$\begin{aligned} r_{y_2y_1} &= P_{Y_2X_1}(P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1}) + P_{Y_2X_2}(P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{x_2x_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2}) \\ &+ P_{Y_2X_3}(P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3}) + P_{Y_2X_4}(P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4}) r_{x_4y_1} \\ &+ P_{Y_2Y_1} r_{y_1y_1} \end{aligned} \tag{39}$$

$$\begin{aligned} r_{y_2y_1} &= P_{Y_2X_1} P_{Y_1X_1} r_{x_1x_1} + P_{Y_2X_1} P_{Y_1X_2} r_{x_2x_1} + P_{Y_2X_1} P_{Y_1X_3} r_{x_3x_1} + P_{Y_2X_1} P_{Y_1X_4} r_{x_4x_1} + P_{Y_2X_2} P_{Y_1X_1} r_{x_1x_2} + P_{Y_2X_2} P_{Y_1X_2} r_{x_2x_2} + P_{Y_2X_2} P_{Y_1X_3} r_{x_3x_2} \\ &+ P_{Y_2X_2} P_{Y_1X_4} r_{x_4x_2} + P_{Y_2X_3} P_{Y_1X_1} r_{x_1x_3} + P_{Y_2X_3} P_{Y_1X_2} r_{X_2X_3} + P_{Y_2X_3} P_{Y_1X_3} r_{x_3x_3} + P_{Y_2X_3} P_{Y_1X_4} r_{x_4x_3} + P_{Y_2X_4} P_{Y_1X_1} r_{x_1x_4} + P_{Y_2X_4} P_{Y_1X_2} r_{X_2X_4} \\ &+ P_{Y_2X_4} P_{Y_1X_3} r_{x_3x_4} + P_{Y_2X_4} P_{Y_1X_4} r_{x_4x_4} + P_{Y_2Y_1} r_{y_1y_1} \end{aligned} \tag{40}$$

$$r_{y_2y_1} = 0{,}392634 \tag{41}$$

$r_{y_2y_1}$ is found as it is stated above.

All effects of the Y_1 on Y_2 in the analysis above have been shown in Table 10.

Table 10: DE, IE, S and U Effects of the Elementary Diploma Grade on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1}\ P_{Y_1X_1}\ r_{x_1x_1}$	S	0,00747	-1,903
$P_{Y_2X_1}\ P_{Y_1X_2}\ r_{x_2x_1}$	U	– 0,00521	-1,326
$P_{Y_2X_1}\ P_{Y_1X_3}\ r_{x_3x_1}$	U	0,000297	0,0756
$P_{Y_2X_1}\ P_{Y_1X_4}\ r_{x_4x_1}$	U	0,002575	0,656
$P_{Y_2X_2}\ P_{Y_1X_1}\ r_{x_1x_2}$	U	– 0,0051	-1,299
$P_{Y_2X_2}\ P_{Y_1X_2}\ r_{x_2x_2}$	S	– 0,01741	-4,434
$P_{Y_2X_2}\ P_{Y_1X_3}\ r_{x_3x_2}$	U	0,000707	0,18
$P_{Y_2X_2}\ P_{Y_1X_4}\ r_{x_4x_2}$	U	0,003382	0,8613
$P_{Y_2X_3}\ P_{Y_1X_1}\ r_{x_1x_3}$	U	0,009927	2,5283
$P_{Y_2X_3}\ P_{Y_1X_2}\ r_{x_2x_3}$	U	0,024111	6,1409
$P_{Y_2X_3}\ P_{Y_1X_3}\ r_{x_3x_3}$	S	– 0,00987	-2,513
$P_{Y_2X_3}\ P_{Y_1X_4}\ r_{x_4x_3}$	U	– 0,0072	-1,834
$P_{Y_2X_4}\ P_{Y_1X_1}\ r_{x_1x_4}$	U	– 0,00715	-1,82
$P_{Y_2X_4}\ P_{Y_1X_2}\ r_{x_2x_4}$	U	– 0,00957	-2,439
$P_{Y_2X_4}\ P_{Y_1X_3}\ r_{x_3x_4}$	U	0,000598	0,1522
$P_{Y_2X_4}\ P_{Y_1X_4}\ r_{x_4x_4}$	S	0,011011	2,8044
$P_{Y_2Y_1}\ r_{y_1y_1}$	DE	0,409	104,1682
Total	$r_{y_2y_1}$	0,393	100

When the values of (7), (9), (16), (18), (25), (27), (34), (36) and (41) found as the analyses' result are compared to the Table 1, it is going to be seen that the result is same with the correlation values given in the table. Since the purpose of the path analysis is to separate the correlation between the variables into components; it is necessary for all components' total to be equal to the correlation between the variables. For the obtained correlations values to equal with the correlation values given in the tables specified above corresponds one – to – one with the path model we established.

Separation of the Correlations between the Demographic Variables Affecting the Physics Achievement into Components in the Path Model Established for the CA7E Approach

In this section, analysis related to demographic characteristics which affect achievement of students' physics achievement for CA7E Approach had been given.

Analyses Concerning with the effects of demographic characteristics to the Achievement in the CA7E Approach

When the correlations between the variables are separated into components and if the correlation between the X_1 and Y_2 is written by separating the components as it is seen below,

$$r_{y_2x_1} = \left[P_{Y_2X_1}\, P_{Y_2X_2}\, P_{Y_2X_3}\, P_{Y_2X_4}\, P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_1} \\ r_{x_2x_1} \\ r_{x_3x_1} \\ r_{x_4x_1} \\ r_{y_1x_1} \end{bmatrix} \quad (42)$$

$$r_{y_2x_1} = P_{Y_2X_1} r_{x_1x_1} + P_{Y_2X_2} r_{x_2x_1} + P_{Y_2X_3} r_{x_3x_1} + P_{Y_2X_4} r_{x_4x_1} + P_{Y_2Y_1} r_{y_1x_1} \quad (43)$$

$r_{y_2x_1}$ is found as it is explained above.

it is necessary to state the expansions of the $r_{x_1x_1}$, $r_{x_2x_1}$, $r_{x_3x_1}$, $r_{x_4x_1}$, and $r_{y_1x_1}$. Since the $r_{x_1x_1}$, $r_{x_2x_1}$, $r_{x_3x_1}$, and $r_{x_4x_1}$ are the correlations between the exogenous variables, their values given in the Table 1 is used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for $r_{y_1x_1}$ to be turned into the matrix form as it is in $r_{y_2x_1}$. When the $r_{y_1x_1}$ is written in the matrix form and the necessary operations are performed $r_{y_1x_1}$,

$$r_{y_1x_1} = \left[P_{Y_1X_1}\, P_{Y_1X_2}\, P_{Y_1X_3}\, P_{Y_1X_4}\right] \begin{bmatrix} r_{x_1x_1} \\ r_{x_2x_1} \\ r_{x_3x_1} \\ r_{x_4x_1} \end{bmatrix} \quad (44)$$

$$r_{y_1x_1} = P_{Y_1X_1} r_{X_1X_1} + P_{Y_1X_2} r_{X_2X_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1} \quad (45)$$

found as it is explained above.

When the correlation between X_1 and Y_2 is separated into its components,

$$r_{y_2x_1} = P_{Y_2X_1} r_{x_1x_1} + P_{Y_2X_2} r_{x_2x_1} + P_{Y_2X_3} r_{x_3x_1} + P_{Y_2X_4} r_{x_4x_1} + P_{Y_2Y_1}(P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1}) \quad (46)$$

$$r_{y_2x_1} = P_{Y_2X_1} r_{x_1x_1} + P_{Y_2X_2} r_{x_2x_1} + P_{Y_2X_3} r_{x_3x_1} + P_{Y_2X_4} r_{x_4x_1} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_1} + P_{Y_2Y_1} P_{Y_1X_2} r_{x_2x_1} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_1} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_1} \quad (47)$$

$r_{y_2x_1}$ = 0,040 (48)

$r_{y_2x_1}$ is found as it is explained above.

All effects of the X_1 on Y_2 in the above analysis have been shown in Table 11.

Table 11: DE, IE, S and U Effects of the Mother's Education Level on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage(%)
$P_{Y_2X_1} r_{x_1x_1}$	DE	-0,087	-215
$P_{Y_2X_2} r_{x_2x_1}$	U	0,0202	50
$P_{Y_2X_3} r_{x_3x_1}$	U	0,0048	11,8
$P_{Y_2X_4} r_{x_4x_1}$	U	0,0874	216
$P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_1}$	IE	0,0047	11,7
$P_{Y_2Y_1} P_{Y_1X_2} r_{x_2x_1}$	U	0,0069	17
$P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_1}$	U	-0,0002	-0,5
$P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_1}$	U	0,0036	9
Total	$r_{y_2x_1}$	0,040	100

When the correlation ($r_{y_1x_1}$) between the X_1 and Y_1 is separated into its components as it is shown below,

$$r_{y_1x_1} = P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1} \quad (49)$$

$$r_{y_1x_1} = 0,242 \quad (50)$$

$r_{y_1x_1}$ is found as it is stated above.

All effects of the X_1 on Y_1 in the analysis above have been shown in the Table 12.

Table 12. DE, IE, S and U Effects of the Mother's Education Level on the Elementary School Diploma Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1} r_{x_1x_1}$	DE	0,076	31
$P_{Y_1X_2} r_{x_2x_1}$	U	0,11	46
$P_{Y_1X_3} r_{x_3x_1}$	U	0,003	-1
$P_{Y_1X_4} r_{x_4x_1}$	U	0,059	24
Total	$r_{y_1x_1}$	0,242	100

Correlation ($r_{y_2x_2}$) between the X_2 andY_2 is separated into its components as shown below.

When $r_{y_2x_2}$ is written as below,

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

$$r_{y_2x_2} = \left[P_{Y_2X_1}\, P_{Y_2X_2}\, P_{Y_2X_3}\, P_{Y_2X_4}\, P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_2} \\ r_{x_2x_2} \\ r_{x_3x_2} \\ r_{x_4x_2} \\ r_{y_1x_2} \end{bmatrix} \tag{51}$$

$$r_{y_2x_2} = P_{Y_2X_1} r_{x_1x_2} + P_{Y_2X_2} r_{x_2x_2} + P_{Y_2X_3} r_{x_3x_2} + P_{Y_2X_4} r_{x_4x_2} + P_{Y_2Y_1} r_{y_1x_2} \tag{52}$$

$r_{y_2x_2}$ is found as it is shown above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of $r_{x_1x_2}$, $r_{x_2x_2}$, $r_{x_3x_2}$, $r_{x_4x_2}$ and $r_{y_1x_2}$. Since the $r_{x_1x_2}$, $r_{x_2x_2}$, $r_{x_3x_2}$ and $r_{x_4x_2}$ are the correlations between the exogenous variables the values given in the Table 1 for them are used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for $r_{y_1x_2}$ to be turned into the matrix form as it is in $r_{y_2x_2}$. When the $r_{y_1x_2}$ is written in the matrix form and the necessary operations are performed $r_{y_1x_2}$,

$$r_{y_1x_2} = \left[P_{Y_1X_1}\, P_{Y_1X_2}\, P_{Y_1X_3}\, P_{Y_1X_4}\right] \begin{bmatrix} r_{x_1x_2} \\ r_{x_2x_2} \\ r_{x_3x_2} \\ r_{x_4x_2} \end{bmatrix} \tag{53}$$

$$r_{y_1x_2} = P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{X_2X_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2} \tag{54}$$

It is found as it is explained above.
When the correlation between the X_2 and Y_2 is separated into its components,

$$r_{y_2x_2} = P_{Y_2X_1} r_{x_1x_2} + P_{Y_2X_2} r_{x_2x_2} + P_{Y_2X_3} r_{x_3x_2} + P_{Y_2X_4} r_{x_4x_2} + P_{Y_2Y_1}(P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{X_2X_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2}) \tag{55}$$

$$r_{y_2x_2} = P_{Y_2X_1} r_{x_1x_2} + P_{Y_2X_2} r_{x_2x_2} + P_{Y_2X_3} r_{x_3x_2} + P_{Y_2X_4} r_{x_4x_2} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_2} + P_{Y_2Y_1} P_{Y_1X_2} r_{X_2X_2} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_2} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_2} \tag{56}$$

$$r_{y_2x_2} = 0{,}111 \tag{57}$$

$r_{y_2x_2}$ is found as it is shown above.

All effects of the X_2 on Y_2 in the above analysis have been shown in the Table 13.

Table 13: DE, IE, S and U Effects of the Family's Income Level on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1}r_{x_1x_2}$	U	-0,045	-39,5
$P_{Y_2X_2}r_{x_2x_2}$	DE	0,039	34,2
$P_{Y_2X_3}r_{x_3x_2}$	U	0,010	10,5
$P_{Y_2X_4}r_{x_4x_2}$	U	0,089	78,1
$P_{Y_2Y_1}P_{Y_1X_1}r_{x_1x_2}$	U	0,002	2,1
$P_{Y_2Y_1}P_{Y_1X_2}r_{x_2x_2}$	IE	0,013	11,6
$P_{Y_2Y_1}P_{Y_1X_3}r_{x_3x_2}$	U	-0,0004	-0,3
$P_{Y_2Y_1}P_{Y_1X_4}r_{x_4x_2}$	U	0,0037	3,3
Total	$r_{y_2x_2}$	0,111	100

When the correlation ($r_{y_1x_2}$) between X_2 and Y_1 is separated into its components as shown below,

$$r_{y_1x_2} = P_{Y_1X_1}r_{x_1x_2} + P_{Y_1X_2}r_{x_2x_2} + P_{Y_1X_3}r_{x_3x_2} + P_{Y_1X_4}r_{x_4x_2} \quad (58)$$

$$r_{y_1x_2} = 0{,}306 \quad (59)$$

$r_{y_1x_2}$ is found as it is shown above.

All effects of the X_2 on Y_1 in the above analysis have been shown in Table 14.

Table 14: DE, IE, S and U Effects of the Family's Income Level on the Elementary School Diploma Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1}r_{x_1x_2}$	U	0,039	13
$P_{Y_1X_2}r_{x_2x_2}$	DE	0,214	70
$P_{Y_1X_3}r_{x_3x_2}$	U	– 0,007	-2
$P_{Y_1X_4}r_{x_4x_2}$	U	0,060	19
Total	$r_{y_1x_2}$	0,306	100

Correlation $r_{y_2x_3}$ between the X_3 and Y_2 is separated into its components as below.

When the $r_{y_2x_3}$ is written as below,

$$r_{y_2x_3} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_3} \\ r_{x_2x_3} \\ r_{x_3x_3} \\ r_{x_4x_3} \\ r_{y_1x_3} \end{bmatrix} \quad (60)$$

$$r_{y_2x_3} = P_{Y_2X_1} r_{x_1x_3} + P_{Y_2X_2} r_{x_2x_3} + P_{Y_2X_3} r_{x_3x_3} + P_{Y_2X_4} r_{x_4x_3} + P_{Y_2Y_1} r_{y_1x_3} \quad (61)$$

$r_{y_2x_3}$ is found as above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of $r_{x_1x_3}$, $r_{x_2x_3}$, $r_{x_3x_3}$, $r_{x_4x_3}$, and $r_{y_1x_3}$. Since the $r_{x_1x_3}$, $r_{x_2x_3}$, $r_{x_3x_3}$, and $r_{x_4x_3}$ are the correlations between the exogenous variables, the values given in the Table 1 for them are used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for $r_{y_1x_3}$ to be turned into the matrix form as it is in $r_{y_2x_3}$. When the ry_1x_3 is written in the matrix form and the necessary operations are performed $r_{y_1x_3}$,

$$r_{y_1x_3} = \left[P_{Y_1X_1} P_{Y_1X_2} P_{Y_1X_3} P_{Y_1X_4}\right] \begin{bmatrix} r_{x_1x_3} \\ r_{x_2x_3} \\ r_{x_3x_3} \\ r_{x_4x_3} \end{bmatrix} \quad (62)$$

$$r_{y_1x_3} = P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3} \quad (63)$$

found as shown above.
When the correlation between X_3 and Y_2 is separated into its components,

$$r_{y_2x_3} = P_{Y_2X_1} r_{x_1x_3} + P_{Y_2X_2} r_{x_2x_3} + P_{Y_2X_3} r_{x_3x_3} + P_{Y_2X_4} r_{x_4x_3} + P_{Y_2Y_1}(P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3}) \quad (64)$$

$$r_{y_2x_3} = P_{Y_2X_1} r_{x_1x_3} + P_{Y_2X_2} r_{x_2x_3} + P_{Y_2X_3} r_{x_3x_3} + P_{Y_2X_4} r_{x_4x_3} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_3} + P_{Y_2Y_1} P_{Y_1X_2} r_{X_2X_3} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_3} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_3} \quad (65)$$

$$r_{y_2x_3} = 0{,}081 \quad (66)$$

$r_{y_2x_3}$ is found as above.

All effects of the X_3 on Y_2 in the above analysis have been shown in Table 15.

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

Table 15: DE, IE, S and U Effects of the Gender on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1} r_{x_1x_3}$	U	-0,011	-13,4
$P_{Y_2X_2} r_{x_2x_3}$	U	0,010	12,5
$P_{Y_2X_3} r_{x_3x_3}$	DE	0,038	46,6
$P_{Y_2X_4} r_{x_4x_3}$	U	0,040	49,4
$P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_3}$	U	0,0006	0,7
$P_{Y_2Y_1} P_{Y_1X_2} r_{x_2x_3}$	U	0,0035	4,2
$P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_3}$	IE	-0,0016	-2
$P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_3}$	U	0,0017	2
Total	$r_{y_2x_3}$	0,081	100

When the correlation ($r_{y_1x_3}$) between the X_3 and Y_1 is separated into its components as below,

$$r_{y_1x_3} = P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3} \tag{67}$$

$$r_{y_1x_3} = 0{,}066 \tag{68}$$

$r_{y_1x_3}$ is found as above.

All effects of the X_3 on Y_1 in the above analysis have been shown in Table 16.

Table 16: DE, IE, S and U Effects of the Gender on the Elementary School Diploma Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1} r_{x_1x_3}$	U	0,010	14
$P_{Y_1X_2} r_{x_2x_3}$	U	0,055	84
$P_{Y_1X_3} r_{x_3x_3}$	DE	– 0,026	-39
$P_{Y_1X_4} r_{x_4x_3}$	U	0,027	40
Total	$r_{y_1x_3}$	0,066	100

Correlation ($r_{y_2x_4}$) between the X_4 and Y_2 is separated into its components as below.

When $r_{y_2x_4}$ is written as below,

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

$$r_{y_2x_4} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1x_4} \\ r_{x_2x_4} \\ r_{x_3x_4} \\ r_{x_4x_4} \\ r_{y_1x_4} \end{bmatrix} \tag{69}$$

$$r_{y_2x_4} = P_{Y_2X_1} r_{x_1x_4} + P_{Y_2X_2} r_{x_2x_4} + P_{Y_2X_3} r_{x_3x_4} + P_{Y_2X_4} r_{x_4x_4} + P_{Y_2Y_1} r_{y_1x_4} \tag{70}$$

$r_{y_2x_4}$ is found as shown above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of the $r_{x_1x_4}$, $r_{x_2x_4}$, $r_{x_3x_4}$, $r_{x_4x_4}$, and $r_{y_1x_4}$. Since the $r_{x_1x_4}$, $r_{x_2x_4}$, $r_{x_3x_4}$, and $r_{x_4x_4}$ are the correlations between the exogenous variables, their values given in the Table 1 is used exactly. However, due to the fact that the Y_1 variable is an endogenous variable it is necessary for ry_1x_4 to be turned into the matrix form as it is in $r_{y_2x_4}$. When the $r_{y_1x_4}$ is written in the matrix form and the necessary operations are performed $r_{y_1x_4}$,

$$r_{y_1x_4} = \left[P_{Y_1X_1} P_{Y_1X_2} P_{Y_1X_3} P_{Y_1X_4}\right] \begin{bmatrix} r_{x_1x_4} \\ r_{x_2x_4} \\ r_{x_3x_4} \\ r_{x_4x_4} \end{bmatrix} \tag{71}$$

$$r_{y_1x_4} = P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4} \tag{72}$$

found as it is above.

When the correlation between the X_3 and Y_2 is separated into its components,

$$r_{y_2x_4} = P_{Y_2X_1} r_{x_1x_4} + P_{Y_2X_2} r_{x_2x_4} + P_{Y_2X_3} r_{x_3x_4} + P_{Y_2X_4} r_{x_4x_4} + P_{Y_2Y_1}(P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4}) \tag{73}$$

$$r_{y_2x_4} = P_{Y_2X_1} r_{x_1x_4} + P_{Y_2X_2} r_{x_2x_4} + P_{Y_2X_3} r_{x_3x_4} + P_{Y_2X_4} r_{x_4x_4} + P_{Y_2Y_1} P_{Y_1X_1} r_{x_1x_4} + P_{Y_2Y_1} P_{Y_1X_2} r_{X_2X_4} + P_{Y_2Y_1} P_{Y_1X_3} r_{x_3x_4} + P_{Y_2Y_1} P_{Y_1X_4} r_{x_4x_4} \tag{74}$$

$$r_{y_2x_4} = 0{,}134 \tag{75}$$

$r_{y_2x_4}$ is found as explained above.

All effects of the X_4 on Y_2 in the analyses above have been shown in Table 17.

Table 17: DE, IE, S and U Effects of the Father's Education Level on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1}r_{x_1x_4}$	U	-0,055	-41,2
$P_{Y_2X_2}r_{x_2x_4}$	U	0,025	18,8
$P_{Y_2X_3}r_{x_3x_4}$	U	0,011	8,3
$P_{Y_2X_4}r_{x_4x_4}$	DE	0,137	101,6
$P_{Y_2Y_1}P_{Y_1X_1}r_{x_1x_4}$	U	0,003	2,2
$P_{Y_2Y_1}P_{Y_1X_2}r_{x_2x_4}$	U	0,008	6,4
$P_{Y_2Y_1}P_{Y_1X_3}r_{x_3x_4}$	U	-0,0005	-0,3
$P_{Y_2Y_1}P_{Y_1X_4}r_{x_4x_4}$	IE	0,005	4,2
Total	$r_{y_2x_4}$	0,134	100

When the correlation ($r_{y_1x_4}$) between the X_4 and Y_1 is separated into its components as below,

$$r_{y_1x_4} = P_{Y_1X_1}r_{x_1x_4} + P_{Y_1X_2}r_{X_2X_4} + P_{Y_1X_3}r_{x_3x_4} + P_{Y_1X_4}r_{x_4x_4} \quad (76)$$

$$r_{y_1x_4} = 0{,}271 \quad (77)$$

$r_{y_1x_4}$ is found as shown above.

All effects of the X_4 on Y_1 in the above analysis have been shown in Table 18.

Table 18. DE, IE, S and U Effects of the Father's Education Level on the Elementary School Diploma Grade

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_1X_1}r_{x_1x_4}$	U	0,048	17
$P_{Y_1X_2}r_{x_2x_4}$	U	0,139	51
$P_{Y_1X_3}r_{x_3x_4}$	U	-0,008	-2
$P_{Y_1X_4}r_{x_4x_4}$	DE	0,092	34
Total	$r_{y_1x_4}$	0,271	100

Correlation ($r_{y_2y_1}$) between the Y_1 and Y_2 is separated into its components as below.

When $r_{y_2y_1}$ is written as below,

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

$$r_{y_2y_1} = \left[P_{Y_2X_1} P_{Y_2X_2} P_{Y_2X_3} P_{Y_2X_4} P_{Y_2Y_1}\right] \begin{bmatrix} r_{x_1y_1} \\ r_{x_2y_1} \\ r_{x_3y_1} \\ r_{x_4y_1} \\ r_{y_1y_1} \end{bmatrix} \tag{78}$$

$$r_{y_2y_1} = P_{Y_2X_1} r_{x_1y_1} + P_{Y_2X_2} r_{x_2y_1} + P_{Y_2X_3} r_{x_3y_1} + P_{Y_2X_4} r_{x_4y_1} + P_{Y_2Y_1} r_{y_1y_1} \tag{79}$$

$r_{y_2y_1}$ is found as above.

In order to this expression to be written in a clear form, it is necessary to state the expansions of rx_1y_1, rx_2y_1, rx_3y_1, rx_4y_1 and ry_1y_1. Since the rx_1y_1, rx_2y_1, rx_3y_1, rx_4y_1 and ry_1y_1 have been found as [(45), (54), (63) and (72)] in the previous operations and written in matrix form. For this reason there was no need for repeating these matrixes and directly written in places of their open forms below.

$$r_{y_1x_1} = P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1}$$
$$r_{y_1x_2} = P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{x_2x_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2}$$
$$r_{y_1x_3} = P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3}$$
$$r_{y_1x_4} = P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4}$$

When these values are written in their places in equation 79, $r_{y_2y_1}$,

$$\begin{aligned} r_{y_2y_1} &= P_{Y_2X_1}(P_{Y_1X_1} r_{x_1x_1} + P_{Y_1X_2} r_{x_2x_1} + P_{Y_1X_3} r_{x_3x_1} + P_{Y_1X_4} r_{x_4x_1}) + P_{Y_2X_2}(P_{Y_1X_1} r_{x_1x_2} + P_{Y_1X_2} r_{x_2x_2} + P_{Y_1X_3} r_{x_3x_2} + P_{Y_1X_4} r_{x_4x_2}) \\ &+ P_{Y_2X_3}(P_{Y_1X_1} r_{x_1x_3} + P_{Y_1X_2} r_{X_2X_3} + P_{Y_1X_3} r_{x_3x_3} + P_{Y_1X_4} r_{x_4x_3}) + P_{Y_2X_4}(P_{Y_1X_1} r_{x_1x_4} + P_{Y_1X_2} r_{X_2X_4} + P_{Y_1X_3} r_{x_3x_4} + P_{Y_1X_4} r_{x_4x_4}) r_{x_4y_1} \\ &+ P_{Y_2Y_1} r_{y_1y_1} \end{aligned} \tag{80}$$

$$\begin{aligned} r_{y_2y_1} &= P_{Y_2X_1} P_{Y_1X_1} r_{x_1x_1} + P_{Y_2X_1} P_{Y_1X_2} r_{x_2x_1} + P_{Y_2X_1} P_{Y_1X_3} r_{x_3x_1} + P_{Y_2X_1} P_{Y_1X_4} r_{x_4x_1} + P_{Y_2X_2} P_{Y_1X_1} r_{x_1x_2} + P_{Y_2X_2} P_{Y_1X_2} r_{x_2x_2} + P_{Y_2X_2} P_{Y_1X_3} r_{x_3x_2} \\ &+ P_{Y_2X_2} P_{Y_1X_4} r_{x_4x_2} + P_{Y_2X_3} P_{Y_1X_1} r_{x_1x_3} + P_{Y_2X_3} P_{Y_1X_2} r_{X_2X_3} + P_{Y_2X_3} P_{Y_1X_3} r_{x_3x_3} + P_{Y_2X_3} P_{Y_1X_4} r_{x_4x_3} + P_{Y_2X_4} P_{Y_1X_1} r_{x_1x_4} + P_{Y_2X_4} P_{Y_1X_2} r_{X_2X_4} \\ &+ P_{Y_2X_4} P_{Y_1X_3} r_{x_3x_4} + P_{Y_2X_4} P_{Y_1X_4} r_{x_4x_4} + P_{Y_2Y_1} r_{y_1y_1} \end{aligned} \tag{81}$$

$$r_{y_2y_1} = 0{,}093 \tag{82}$$

is found as above.

All effects of the Y_1 on Y_2 in the above analysis are shown in Table 19.

International Journal on New Trends in Education and Their Implications
October 2012 Volume: 3 Issue: 4 Article: 20 ISSN 1309-6249

Table 19: DE, IE, S and U Effects of the Elementary School Diploma Grade on the Achievement Test

P_{ij}	Form of Effect	Magnitude	Percentage (%)
$P_{Y_2X_1}\ P_{Y_1X_1}\ r_{x_1x_1}$	S	-0,0066	-7,14
$P_{Y_2X_1}\ P_{Y_1X_2}\ r_{x_2x_1}$	U	- 0,0096	-10,41
$P_{Y_2X_1}\ P_{Y_1X_3}\ r_{x_3x_1}$	U	0,0003	0,31
$P_{Y_2X_1}\ P_{Y_1X_4}\ r_{x_4x_1}$	U	– 0,0051	-5,51
$P_{Y_2X_2}\ P_{Y_1X_1}\ r_{x_1x_2}$	U	0,0015	1,66
$P_{Y_2X_2}\ P_{Y_1X_2}\ r_{x_2x_2}$	S	0,0083	9,01
$P_{Y_2X_2}\ P_{Y_1X_3}\ r_{x_3x_2}$	U	– 0,0003	-0,29
$P_{Y_2X_2}\ P_{Y_1X_4}\ r_{x_4x_2}$	U	0,0023	2,52
$P_{Y_2X_3}\ P_{Y_1X_1}\ r_{x_1x_3}$	U	0,0004	0,39
$P_{Y_2X_3}\ P_{Y_1X_2}\ r_{x_2x_3}$	U	0,0021	2,29
$P_{Y_2X_3}\ P_{Y_1X_3}\ r_{x_3x_3}$	S	– 0,0010	-1,07
$P_{Y_2X_3}\ P_{Y_1X_4}\ r_{x_4x_3}$	U	0,0010	1,11
$P_{Y_2X_4}\ P_{Y_1X_1}\ r_{x_1x_4}$	U	0,0066	7,17
$P_{Y_2X_4}\ P_{Y_1X_2}\ r_{x_2x_4}$	U	0,019	20,57
$P_{Y_2X_4}\ P_{Y_1X_3}\ r_{x_3x_4}$	U	– 0,0010	-1,13
$P_{Y_2X_4}\ P_{Y_1X_4}\ r_{x_4x_4}$	S	0,0126	13,60
$P_{Y_2Y_1}\ r_{y_1y_1}$	DE	0,062	66,91
Total	$r_{y_2y_1}$	0,093	100

When the values (48), (50), (57), (59), (66), (68), (75), (77) and (82) found as the analyses' result compared with Table 1; it is going to be seen that the result is the same with the correlation values given in the table. Since the purpose of the path analysis is to separate the correlation between the variables into components; it is necessary for all components' total to be equal to the correlation between the variables. For the obtained correlations values to equal with the correlation values given in the tables specified above corresponds one – to – one with the path model we established.

DISCUSSION

The path analysis in its core is the method of separating the coefficient's components between the variables. It is a method that shows the contribution margins of each of the variables to this correlation and a method that has relative results in some respects by considering all the variables, which are being analyzed collectively and not tackling the single correlation between the two variables on its own. The components' effect margins forming the correlation as connected to the increase and decrease of variables changes' number. In this study, only five variables have been handled and the unobservable affects that each of the variable's observable and together with the other variables effect over the result variables have been analyzed. The other variables' effects that remain outside of the variables considered in this study have been stated with a symbol of "e" and their effect value has been shown however, they have not been used in the path analysis's calculations. When looking at the effects' path coefficients shown with the symbol "e" (Figure 1); it is seen that these values are larger than the variables' path coefficients used in our study in certain stated forms. It has been realized from the findings obtained that the variables remaining on the outside of the variables used in this study will also have significant effects over the result variables. The contributions provided to the education area are going to increase with studies using more variables.

While the data belonging to the students in each of two groups have been analyzing; the mother's education level, family's income status, gender, father's education level on the student's achievement and on the elementary school achievement and the student's grade have been discussed in the first step and in the second step on the other hand, these variables' effects together with the elementary school diploma grade on the student's achievement has been discussed.

Since the effect's table evaluation for each one of the reason variable on the result variable in the path analysis is made with a similar logic, only the interpretations belonging to the first two tables (Table 2 and Table 3) have been given in a clear form here.

Separating the Mother's Education Level's Effects in the Student Groups Receiving Education with CACL on the Student's Achievement and Elementary School Diploma Grade into their Components

When Table 1 is examined, the correlation between the obtained the student's achievement score and the mother's education level is seen as 0.030. According to the value in the Table 1, there is a positive direction between the mother's education level and the achievement that the student achieved in this study. With a clearer statement, it is seen as if an increase in the mother's education level is affecting the student's achievement in this study in a positive direction. When this correlation is separated into its components (Table 2) on the other hand, the mother's education level's observable effect on the student's achievement is -0.045 and the contribution of this size in the correlation on the other hand is a negative value of 149%. The unobservable contribution (IE) that the mother's education level adds to the student's achievement over the elementary school diploma grade has a size of 0.068 and contribution share of 225%. There are also U effects that the mother's level of education has over the student's achievement. These are the effects made over the family's income level, gender and father's level of education respectively. And their sizes and contribution shares in the total respectively are in form of -0.031 (102% negative), 0.060 (198% negative) and -0.043 (143% negative). There are also three different U effects originating from the relationship between the other variables (family's income level, gender and the father's education level respectively) of the mother's education level made over the elementary school diploma grade. And their sizes and contribution shares in the total respectively are in form of 0.047 (157%), (-0.003 (9% negative) and -0.023 (77% negative). If looked closely the observable effect of the mother's education level on the student's achievement is in the negative direction and while it is nearly 1.5 times larger that the observed value, this negativity gets removed with the total contributions of the unobservable effects (IE and U) and shown a positive effect to the achievement as a result. Also, while the mother's education level makes a negative impact to the measured achievement in our study, it made a positive impact on the student's elementary school achievement and the elementary school achievement's increase sourcing from this positive impact has provided the biggest contribution to the student's achievement (225%).

In the same way, the effects of the mother's education level over the elementary school diploma grade of the student are given in Table 3. The size of the observable correlation coefficient between the two variables in Table 3 is seen as 0.217 and as a positive effect. When we separate the value of this correlation into its components, the mother's education level has one observable (DE) and three unobservable U effects which are origination from the relationships with the family's income level, gender and the father's education level respectively over the elementary school diploma grade of the student. While the size and contribution in total of the observable effect is 0.166 (76%), the sizes and contributions in total of the U effects origination from the relationship between the reason variables are in form of 0.115 (53%), -0.007 (3% negative) and -0.057 (26% negative) respectively. The observable effect of the mother's education on the elementary school diploma grade forms only the three quarters of the total effect. An effect about the half the proportion of the total effect on the other hand rises from the U effect that the mother's education level makes over the family's income level. Even thought the total of the both effects is greater that the total effect (0.217) this effect with the negative U effects made over the gender and father's education level this effect has decreased and an observable correlation has been formed.

Relationships Found Significant from the Statistical Angle in the Path Analysis

When we analyze the relationships between the cause (reason) and affect (result) variables according to this method suggested by Kocakaya (2008) and when we examine the correlation values in the Table 1 for analyzing the demographic variables' effects (X_1: Mother's education level, X_2: Family's income level, X_3: Gender and X_4: Father's education level) on Y_1 (Elementary school diploma grade) and all their influences together with Y_1 on the Y_2 (the students' physics achievement scores in the study); consistency coefficients obtained by following the method suggested above are found in form of,

$T(X_1:Y_2) = 0$
$T(X_2:Y_2) = 0$
$T(X_3:Y_2) = 0.5$
$T(X_4:Y_2) = 0$
$T(X_1:Y_1) = 1$
$T(X_2:Y_1) = 1$
$T(X_3:Y_1) = 0$
$T(X_4:Y_1) = 0.5$
$T(Y_1:Y_2) = 0.5$

It has been seen that in the bottom line of the method suggested by Kocakaya (2008), X_1, X_2, X_3 and X_4 have not had a significant influence on Y_2 the result variable. Continuing on with this result, it can be said that the demographic characteristics tackled in this short study of four weeks have not had influence over the physics achievement that the student obtained in the study. Together with this, due to the fact that the consistency coefficients between the X_1, X_2, and X_4 cause variables and the Y_1 affect variable have been not greater values than "0"; it is being thought that the demographic characteristics influence the achievements, which are going to be obtained from long term studies. Also the influence's consistency coefficient of the X_3 variable on Y_1 being "0" has been interpreted as the cause variable X_3 has no influence on the affect variable Y_1. Due to the fact that the demographic characteristics have not had a significant influence on the achievement in short term; it is being considered that the increase seen in the student's achievement occurred in connection to the learning approach applied in the current study.

When the variables with consistency coefficient greater than "0" are examined and since the consistency coefficient between the X_3 and Y_2 are 0.5 the DE values of the both variables in total effect have been taken into consideration. The DE effect of a cause variable on another result variable is once again the correlation ratio between the same two variables of the path correlation between the same two variables given in Figure 1. While the total effect value given in Table 1 for CA7E is 0.081 ($r_{y_2 x_3}$), it has been seen that X_3 has an effect value in size of 0.038 that forms only the 46.6% of this total effect. Together with this, if the contribution of X_3 is 46.6% in the effect in size of 0.081, which is insignificant, is its observable effect; it is a value even lower than the observed correlation. In this case, it can be said that the gender variable do not have a defining role in comparing the achievements of the students, who are receiving education with CA7E. Completely opposite of this condition, a significant relationship between the X_3 and Y_2 has been observed in CACL (P<0.01). When it is considered that the DE contribution of the X_3 in the total effect is 109%, it has been seen that this amount is larger and more significant that the observable correlation value. However, with the other unobservable negative effects over other variables, the effect of X_3 on Y_2 has declined. Despite this significance, parallel to the consistency value $T(X_3:Y_1)$ =0 defined for the gender variable and elementary school achievement, it has been determined that it is not going to be effective on the physics achievement of the student in our short term study and it has not been taken into consideration. It is also being stated in the study of Murray-Harvey (1993) that the gender is not effective on achievement. Murray-Harvey (1993) in their studies have examined the relationships between the studying approaches, learning styles and control areas of the 423 students, who are freshmen in the education and nursing department with the path analysis and researched the effects on their achievements. At the end of the study on the other hand, they have stated that the variance 44% in increasing academic achievement explains (β=0.45) the students recognition of their cognitive abilities and gender, age and learning approaches don't have a significant contribution to achievement. This study is in a supporting quality of our findings on account of indicating that the gender is not an effective factor over the achievement of student.

Due to the fact that the values of $T(X_4:Y_1)$ and $T(Y_1:Y_2)$ are "0.5", the DE values in the total effect formed over the result variable that the each two variables have over the result variable is considered. The observable effect contributions of the $T(X_4:Y_1)$ in the total correlation respectively are an insignificant value of 125% (negative) and -.0121 for CACL and a 24% ratio and 0.092 of an effect for the CA7E. The DE value which has a contribution of only 34% in value of 0.271 can be seen as if it is significant only in the group applied CA7E yet has a very small value that can be qualified as insignificant. Therefore, the interpretation that the X_4 variable, in other words the father's education level, does not have a significant effect on the student's elementary school achievement grade has been made.

The observable contributions of $T(Y_1:Y_2)$ in the total correlation respectively are a significant value of 0.409 and a ratio of 104% for CACL ($P<0.01$) and a non-significant value of 0.062 and a ratio of 66% for CA7E. Due to the fact that the contribution of Y_1 in size of 0.393, which seems to be significant in only the group applied CA7E, is found to be in level of 99% significance; it has been interpreted as the elementary school diploma grade has a positive effect on the student's achievement. This result shows a parallelism with the study results of the (Zeeger , 2004; Archer and friends, 1999 and Lietz, 1996) informing that the initial knowledge and graduation scores of the students have a positive impact on the student's achievement.

The consistency values of $T(X_1:Y_1)$ =1 and $T(X_2:Y_1)$ =1 show that there is a significant relationship between the X_1 and X_2 cause variables and Y_1 affect variable and that the cause variables increased the affect variable in a positive direction. In other words, the increase in the mother's education level and the family's income affect the students' elementary school diploma grade of in a positive direction. It has also been stated this two variables increase the student's achievement in long term in studies where the mother's education level's effects and the family's income level have on the student's achievement are analyzed (Bleeker and Jacobs, 2006; Davis-Kean, 2005; Halle and friends, 1997 and Alexander and friends, 1994). Among these researchers, Halle and friends (1997) and Davis – Kean (2005) also express that the father's education level besides mother's also has a positive effect on the student's achievement.

CONCLUSION AND SUGGESTIONS

In the end of the analyses made with the path analysis; it has been seen that the mother's education level and the family's income level have a clear effect on the student's elementary school diploma grades despite the fact that the demographic characteristics' observable effects on the students' physics achievements obtaining from this study have been not able to be determined [$T(X_1:Y_1)$ =1 and $T(X_2:Y_1)$ =1]. While the demographic characteristics' effects on the achievement are being interpreted, the conclusion that the mentioned demographic characteristics have not been affected the achievement in short termed studies yet the mother's education level, family's income level and the students' initial knowledge providing significant and positive contributions to the achievement in the long termed learning stages have been made. In this context, it is being thought that keeping in consideration of the demographic characteristics while planning the instruction and learning processes in long term stages will make positive contributions to the student's achievement.

BIODATA AND CONTACT ADDRESSES OF AUTHORS

Assist. Prof. Dr. Serhat KOCAKAYA was born in Diyarbakır at 1978 and graduated Department of physics faculty of Education, at Dicle University at 2000, Master of Science at 2004 Dicle Universty institute of Science and phd.2008 at Dicle University institute of science.

He worked at the Department of Physics Education, Faculty of Education, at Dicle University, between 2005-2009. He is working at the Department of Physics Education, Faculty of Education, at Yüzüncü Yıl University, since 2010.

Assist. Prof. Dr. Serhat KOCAKAYA
Yüzüncü Yıl University, Faculty of Education,
Department of Physics education, Faculty of Education,
65080 Zeve Campus/Van, TURKEY
Tel/Fax: 0432 2251024/0432 2251038
E. Mail: skocakaya@gmail.com

Assoc. Prof. Dr. Selahattin GONEN was born in Kars at 1965 and graduated Department of physics faculty of Art and Science, at Dicle University at 1986, Master of Science 1992 at Dicle Universty institute of Science and phd.1995 at Dicle University institute of science.
He is working at the Department of Physics Education, Faculty of Education, at Dicle University, since 1989.

Assoc. Prof. Dr. Selahattin GONEN
Dicle University, Faculty of Education,
Department of Physics education, Faculty of Education,
21280 Campus/Diyarbakir, TURKEY
Fax:+90 412 248 8257 (8819)
E. Mail: sgonen@dicle.edu.tr

REFERENCES

Alexander, K. L., Entwisle, D. R., and Bedinger, S. D. (1994). When Expectations Work: Race and Socioeconomic Differences in School Performance. *Social Psychology Quarterly*, 57, 283–299.

Archer, J. Cantwell, R., and Bourke, S., (1999). Coping at University: An Examination of the Achievement, Motivation, Self-Regulation and Method of Entry. *Higher Education Research & Development*, 18, 31–54.

Bleeker, M., M. and Jacobs, J., E., (2006). Achievement in Math and Science: Do Mothers' Beliefs Matter 12 Years Later? *Journal of Educational Psychology*, 96(1), 97-109.

Davis-Kean, P.E. (2005). The Influence of Parent Education and Family Income on Child Achievement: The Indirect Role of Parental Expectations and the Home Environment. *Journal of Family Psychology*, 19(2), 294–304.

Eccles, J. S. (1993). School and Family Effects on the Ontogeny of Children's Interests, Self-Perceptions, and Activity Choice. In J. Jacobs (Ed.), *Nebraska Symposium on Motivation*: *Vol. 40. Developmental Perspectives on Motivation* (pp. 145–208): Lincoln: University of Nebraska Press.

Halle, T. G., Kurtz-Costes, B. and Mahoney, J. L. (1997). Family Influences on School Achievement in Low-Income, African American Children. *Journal of Educational Psychology*, 89, 527-537.

Haveman, R., and Wolfe, B. (1995). The Determinants of Children's Attainments: A Review of Methods and Findings. *Journal of Economic Literature, 33,* 1829–1878.

Jimerson, S., Egeland, B., and Teo, A. (1999). A Longitudinal Study of Achievement Trajectories Factors Associated with Change. *Journal of Educational Psychology, 91,* 116–126.

Jones, M. G., Howe, A., and RUA, M. J., (2000) Gender Differences in Students' Experiences Interests and Attitudes toward Science and Scientists. *Science Education*. 84,180-192.

Klebanov, P. K., Brooks-Gunn, J., and Duncan, G. J. (1994). Does Neighborhood and Family Poverty Affect Mothers' Parenting, Mental Health, and Social Support? *Journal of Marriage and the Family, 56,* 441–455.

Kocakaya, S. (2008). *Analyzing the Relationships between the Factors that Affect the Achievements of Students in Physics Course with the Path Analysis Technique (In Turkish),* Unpublished Doctorate Thesis, Institute of Science, Dicle University.

Kohn, M. L. (1963). Social Class and Parent-Child Relationships: An Interpretation. *American Journal of Sociology, 68,* 471–480.

Lietz, P., (1996). Learning and Writing Difficulties at the Tertiary Level: The Impact on First-Year Results. *Studies in Educational Evaluation*, *22*, 41–57.

Luster, T., Rhoades, K., and Haas, B. (1989). The Relation between Parental Values and Parenting Behavior: A Test of the Kohn Hypothesis. *Journal of Marriage and the Family, 51,* 139–147.

Murray-Harvey, R., (1993). Identifying Characteristics of Achievementful Tertiary Students Using Path Analysis. *Australian Educational Researcher*, *20*, 63–81.

Smith, J. R., Brooks-Gunn, J., and Klebanov, P. K. (1997). Consequences of Living in Poverty for Young Children's Cognitive and Verbal Ability and Early School Achievement. In G. J. Duncan, and J. Brooks-Gunn (Eds.), *Consequences of growing up poor* (pp. 132–189). New York: Russell Sage Foundation.

Zeegers, P., (2004). Student Learning in Higher Education: A Path Analysis of Academic Achievement in Science. *Higher Education Research & Development*, 23:1, 35 – 56.