A PATH MODEL FOR ANALYZING UNDERGRADUATE STUDENTS' ACHIEVEMENT

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Abstract

The academic success of the students is seen as an important outcome of the academic associations. The factors that are related with the students success is being searched for the last three decades. There are numerous factors can be said that affect students' achievement. In this study we investigate the variables that affect the academic success among the freshmen and sophomores of School of Transportation & Logistics in Istanbul University. We developed a model to research the variables that affects students' achievement by using the path analyses. In proposed students' achievement model, we accept the achievement criteria as grades in social and quantitative courses and analyzed if their high school's achievement is affecting their undergraduate achievement. Also we search for their high school achievements and their demographic factors such as age, sex and besides economic status on their undergraduate achievement.

Keywords: *Path Analysis, Students' Achievement Criteria*

1. INTRODUCTION

Academic achievement is one of the major subjects in the educational researches. Academic achievement is defined as the outcomes of the education. Preventing students from failure is related with identifying the factors affecting the achievement. By defining the important factors affecting the students' achievement, failure can be under controlled [Ozguven, 1974]. Education is a complex process and many factors directly or indirectly may affect achievement. Besides, it is difficult to properly define the major factors influencing students' achievement. Although researchers have identified several factors affecting the student achievement, there are still some arguments about them. Some researchers attribute the student's achievement to the school; others indicate that the school makes little impact on academic outcome. Other researchers say that the effective teacher is the only one who can play the main role in terms of student progress. All the factors such as teacher, school context, classroom context and the community around the school contribute or impact student's achievement somehow [Harris, 1999]. In all these thoughts, we can see that there are three common factors affecting the students' achievement. Factors related with teachers, students and lastly environment. All these factors are affective on the students' grade more or less. In our research, we handle the students' perspective and search for the factors affecting the students' achievement in their demographic items such as age, sex, and their academic background such as high school type, grade, University Entrance score, their families' social and economic status, income, housing, computer knowledge skills and social behaviors and mannerism. The aim of this study is to find out what kinds of factors have effects on students' exam success among the students at School of Transportation and Logistics by using the path analysis.

2. LITERATURE REVIEW

A great deal of attention has been devoted to investigating the academic achievement factors [Dollinger, 2008; Emre, 2002; Gulleroglu, 2005; O'Connor, 2007]. Extensive research has been carried out on in- and out-of-school variables affecting students' achievement such as school factors, self-concept, self-efficacy, attitude, attribution, motivation,

press variables, and gender. Furthermore, the relationships between students' academic achievement and their foreign language knowledge level [Al-Musawi, 1999], usage of information systems [Budus, 2005; Aydin, 2003; Atasoy, 2004], university entrance test scores [Ozdogan, 1988; Erkan, 2004; Otrar, 2006; Demirok, 1990], demographic characteristics [Kilic, 2004], gender differences [Yenilmez, 2006], high school type and section [Tavşancıl, 1989], personality and motivation [Kaufman, 2008; Tournaki, 2005; Farsides, 2003; Busato, 2000] has been studied. Literature on academic achievement is extensive and some findings have shown that females usually score higher on average than males on test of verbal abilities, and that males score higher on average than female on tests of mathematics ability [Halpern, 1996], spatial abilities; and on tests of stereotypically male vocational information and aptitude [Hedge &Nowell, 1995]. Biegel (2000) in a study carried out to determine the interfaces between attendance, academic achievement and equal educational opportunities, observed that there is a direct correlation between class attendance and academic achievement. He explained that students who go to class invariably do better in school and they maximize their chances for success. Unlike these studies are made for the students at different levels, in this study we search for the relations among the students of the School of Transportation and Logistics.

3. METHODOLOGY

A path analysis is a technique that examines the predictive association among the variables over time. It is an extension of multiple regressions in that it involves various multiple regression models or equations that are estimated simultaneously [Lei & Wu2007]. In path analysis, a variable can be a dependent variable in one relationship and an independent variable in another. These variables are referred to as mediating variables. This provides a more effective and direct way of modeling mediation, indirect effects, and other complex relationship among variables.

Path analysis can be considered as a special case of Structural Equation Modeling (SEM) in which structural relations among observed (vs. latent) variables are modeled [Lei & Wu, 2007]. Structural relations are hypotheses about directional influences or causal relations of multiple variables (e.g., how independent variables affect dependent variables). Hence, path analysis is sometimes referred to as causal modeling. Because analyzing interrelations among variables is a major part of SEM and these interrelations are hypothesized to generate specific observed covariance (or correlation) patterns among the variables, SEM is also sometimes called covariance structure analysis. For both types of analyses, observed dependent variables can be continuous, censored, binary, ordered categorical (ordinal), counts, or combinations of these variable types. In addition, in regression analysis and path analysis for non-mediating variables, observed dependent variables can be unordered categorical (nominal).

Path analysis is an extension of regression analysis, a statistical technique for producing a quantitative estimate of how much one variable (the "independent variable") influences another variable (the "dependent variable"). Path analysis models specify hypothesized associations or directional relationships among a set of sequentially ordered variables. Path analysis is a technique that models both direct and indirect causal effects among observed variables of interest and allows the test of the model fit the data. 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 [Kocakaya and Gonen, 2012]

4. PATH ANALYTIC STUDY

The typical steps in a path analysis area as follows;

1. Specifying the network of hypothesized direct casual links among the variables based on the theory, experience, and the literature.
2. The paths in the hypothesized model are estimated after Collecting the relevant data from a sample drawn from the population of interest,
3. Evaluating the adequacy of the model including an assessment of the fit of the model to the observed data.
4. If the model is not adequate, considering one or more revisions of the model.

If an adequate model is obtained, describing the associated estimated causal effects.

4.1. Sample

The data has been taken from randomly selected 240 students in School of Transportation & Logistics in Istanbul University. Our instrument is consisted of a student questionnaire and some exam scores. Questionnaire is carried out to individual students at the end of some courses. We measured their academic achievement by using their grades of "Introduction to Business Administration", "Computer Applications" and "Mathematics" courses and "University Entrance Score". The data related with the exam grades are taken from the students' affair office. Our sample size is large enough to produce valid and reliable results using path analysis (n<150) was selected for inclusion in the analysis.

4.2. Students' Achievement Model

Based on the theory and the associated literature, a model is proposed to evaluate the causal links (relationships among the variables) related with academic achievement. In our proposed model, demographic items such as age, sex, and their academic backgrounds such as high school type, their university entrance score, housing type, income, computer knowledge skill and social behavior and mannerism are included.

Independent Variables in the Model

Age – ex – academic background (School type – University Entrance Score)- their housing type- income-their computer knowledge skills - social behaviors – mannerism- course grades.

Dependent Variables in the Model

An additional decision that researchers employing meta analytic estimates in path analyses and structural equation modeling must make is how to equate sample sizes within each cell in the input correlation matrix when each cell is based on meta analyses employing different sample sizes (see, for example, the cell ns in Tables 1 and 2). The most common solution is to hold the sample sizes constant across cells have been to use either the arithmetic mean or the harmonic mean. We chose to use the harmonic mean because it tends to yield the least biased estimates of standard errors of parameter estimates [Viswesvaran & Ones, 1995].

Our model is shown in Figure.1. In this graphical form, a directional arrow (→) is used to indicate a hypothesized causal direction. The variables to which arrows are pointing are the dependent variables and the variables having no arrows pointing to them are the independent variables. Unexplained covariances among variables are indicated by curved arrows (↔). Observed variables are commonly enclosed in rectangular boxes.

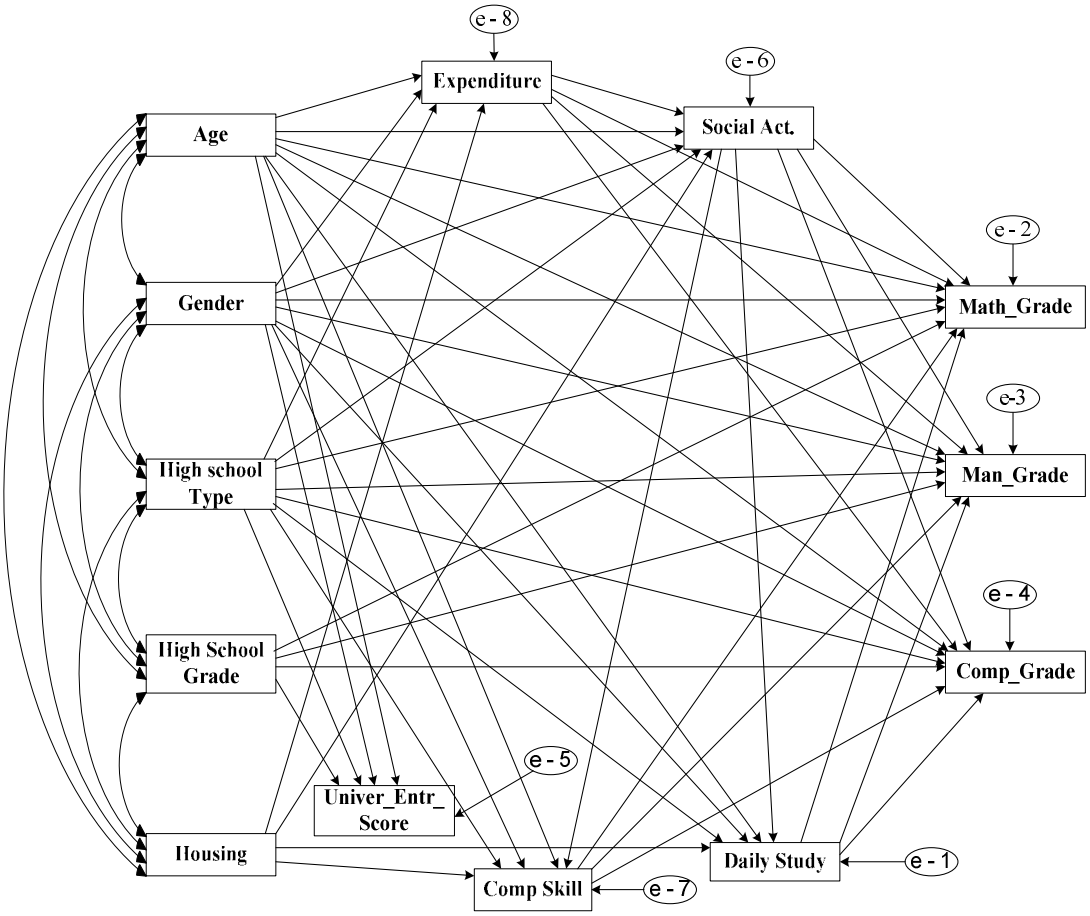

Figure 1. Path Model for Students' Academic Achievement

5. RESULTS OF THE ANALYSIS

The analysis of the data by gender showed that from the eight factors under study seven had significant effects on the girls' mathematics score and totally explained 24.5 percent of the variance in girls' mathematics scores. The most important factors affecting the girls' mathematics achievement were self-concept and home background that accounted for 13.6 and 6.9 percent of the variance in the girls' mathematics score, respectively. External motivation, students' attitudes towards mathematics, teaching, press factor and attribution also explained 1.3, 1.2, 1.2, 0.4 and 0.4 percent of the remaining variance in the girls' mathematics score, respectively. Similar to the total performance of both genders, school climate was the only factor that did not have any effect on the girls' mathematics achievement.

We judged model fit in each of the four analyses on the basis of three primary criteria—the Comparative Fit Index (CFI), Goodness of Fit Index (GFI) and the Standardized Root Mean Squared Residual (SRMR). We chose CFI and SRMR because past Monte Carlo studies [Hu & Bentler, 1999] of the behavior of different fit indices have revealed that a combination of CFI values greater than or equal to .96 and SRMR values of .10 or less never rejected a correct model. In addition, individually, CFI values exceeding .94 and SRMR values of less than .06 are generally considered to indicate excellent model fit, while CFI's of .90 to .94 and SRMR's of .06 to .10 are indicative of acceptable, but marginal fit [Joreskog & Sorbom, 1996]. We also included the GFI as a third primary estimate of model fit because it is an index of absolute fit. The CFI, on the other hand, is an estimate of comparative fit (versus a null relations baseline model) and can yield high values because of a very poorly fitting baseline model rather than an adequately fitting tested model. Consistently high CFI and GFI values would suggest that the tested model adequately fit the data. Although the normal theory weighted least squares v2 is often reported in structural equation model studies, we chose not to use this as a primary index of fit because it usually rejects well-fitting models with samples sizes as large as those employed in our model tests. The Root Mean Square Error of Approximation

(RMSEA), another frequently employed index of model fit, is also very sensitive to large sample sizes and sometimes rejects well-fitting models because it is derived from the normal theory v2 rather than from the residual correlation matrix. The SRMR by contrast is calculated directly from the residual correlation matrix.

Table.1. Goodness of Fit Measures for the Proposed Model

Fit Measure	Default model
Discrepancy	102.718
Degrees of freedom	17
Number of parameters	74
Discrepancy / df	6.042
GFI	0.943

Table.2. Regression Coefficients of Direct Relations

Regression Weights			Estimate	S.E.	C.R.	P	Decision
Expenditure	←	Age	-0.009	0.027	-0.315	0.753	Ho Accept
Expenditure	←	Inhousing	0.142	0.031	4.554	0.000	Ho Reject
Expenditure	←	School_Type	0.065	0.021	3.134	0.002	Ho Reject
Expenditure	←	Gender	0.399	0.073	5.445	0.000	Ho Reject
Social_Act	←	School_Type	-0.002	0.018	-0.087	0.930	Ho Accept
Social_Act	←	Gender	0.079	0.068	1.172	0.241	Ho Accept
Social_Act	←	Age	0.03	0.024	1.258	0.208	Ho Accept
Social_Act	←	Inhousing	0.047	0.028	1.666	0.096	Ho Reject
Social_Act	←	Expenditure	-0.015	0.054	-0.28	0.779	Ho Accept
Daily_Study	←	Inhousing	-0.03	0.063	-0.477	0.633	Ho Accept
Daily_Study	←	Social_Act	0.515	0.138	3.723	0.000	Ho Reject
Comp_Inf	←	Inhousing	-0.039	0.034	-1.131	0.258	Ho Accept
Daily_Study	←	School_Type	0.116	0.041	2.816	0.005	Ho Reject
Comp_Inf	←	School_Type	-0.011	0.023	-0.482	0.630	Ho Accept
Daily_Study	←	Age	0.026	0.053	0.486	0.627	Ho Accept
Daily_Study	←	Expenditure	-0.417	0.121	-3.456	0.001	Ho Reject
Uni. Ent. Score	←	Age	-0.729	0.235	-3.106	0.002	Ho Reject
Comp_Inf	←	Social_Act	0.447	0.078	5.746	0.000	Ho Reject
Uni. Ent. Score	←	Gender	0.786	0.602	1.306	0.192	Ho Accept
Uni. Ent. Score	←	School_Type	-0.395	0.172	-2.292	0.022	Ho Reject
Daily_Study	←	Gender	0.133	0.151	0.88	0.379	Ho Accept
Comp_Inf	←	Gender	0.292	0.08	3.634	0.000	Ho Reject
Comp_Inf	←	Age	0.005	0.03	0.176	0.860	Ho Accept
Uni. Ent. Score	←	School_Grade	-0.725	0.656	-1.105	0.269	Ho Accept
Math_Grade	←	Social_Act	1.049	1.671	0.628	0.530	Ho Accept
Math_Grade	←	Gender	-5.260	1.768	-2.975	0.003	Ho Reject
Math_Grade	←	Age	-1.079	0.645	-1.671	0.095	Ho Reject
Math_Grade	←	Comp_Inf	0.626	1.233	0.508	0.612	Ho Accept
Math_Grade	←	Daily_Study	1.193	0.696	1.715	0.086	Ho Reject
Man_Grade	←	Daily_Study	1.556	0.772	2.015	0.044	Ho Reject
Man_Grade	←	Uni. Ent. Score	0.19	0.185	1.025	0.305	Ho Accept

Man_Grade	←	Age	0.154	0.716	0.215	0.830	Ho Accept
Man_Grade	←	Social_Act	1.316	1.854	0.71	0.478	Ho Accept
Man_Grade	←	Expenditure	-0.697	1.482	-0.47	0.638	Ho Accept
Man_Grade	←	School_Type	1.482	0.536	2.765	0.006	Ho Reject
Man_Grade	←	Comp_Inf	6.472	1.368	4.730	0.000	Ho Reject
Comp_Grade	←	Social_Act	2.086	2.151	0.97	0.332	Ho Accept
Comp_Grade	←	School_Type	1.384	0.622	2.225	0.026	Ho Reject
Comp_Grade	←	Expenditure	-1.291	1.719	-0.751	0.452	Ho Accept
Comp_Grade	←	Age	-1.634	0.831	-1.967	0.049	Ho Reject
Comp_Grade	←	Uni. Ent. Score	0.181	0.215	0.84	0.401	Ho Accept
Comp_Grade	←	Daily_Study	-1.520	0.895	-1.698	0.090	Ho Reject
Comp_Grade	←	Comp_Inf	12.099	1.587	7.623	0.000	Ho Reject
Math_Grade	←	School_Grade	6.864	1.771	3.877	0.000	Ho Reject
Man_Grade	←	School_Grade	3.980	1.965	2.026	0.043	Ho Reject
Comp_Grade	←	School_Grade	7.395	2.279	3.245	0.001	Ho Reject
Math_Grade	←	Expenditure	0.405	1.335	0.303	0.762	Ho Accept
Man_Grade	←	Gender	-10.879	1.962	-5.544	0.000	Ho Reject
Comp_Grade	←	Gender	-2.423	2.276	-1.064	0.287	Ho Accept
Math_Grade	←	School_Type	0.261	0.483	0.54	0.589	Ho Accept
Math_Grade	←	Uni. Ent. Score	0.487	0.167	2.914	0.004	Ho Reject

These results confirm our initial hypothesis that family characteristics can affect students' achievement through the following process: on one hand, families with higher economic levels can choose to invest in cultural resources (according to parent's cultural capital, a measure that is not collinear to that of their economic resources), and consequently, use these resources to improve their level of participation in their children's schooling. An environment surrounded by academic values motivates the student to have a better attitude towards school, increasing their achievement. The examination of the direct and indirect effects of each variable provides an extra tool to confirm the adequacy of the chosen empirical model. The estimate of the total effect of economic resources on proficiency is 6.12. In the presented model used for the analysis, the economic total effect is equal to the indirect effect, since there is not the direct.

6. CONCLUSIONS

This paper provides empirical evidence that family background should not be treated through one overall measure only when assessing its effects in student's achievement. The decomposition of family effects in economic and cultural factors, as well as parent's participation in the students' academic life, is very helpful for educational surveys such as that intend to identify relevant effects to be included in educational public policies. SAEB data provide fair instruments to test the hypothesis that part of the effects of the family's economic level on achievement can be explained by family's values and family decisions about investment on cultural goods. Parents' education boosts this mechanism because it is highly correlated with the presence of cultural goods at the students' home and, consequently, with parent's participation at the students' academic life. Moreover, the combination of economic resources and parent's participation produces a stimulating academic environment at home that is responsible for the students' more positive attitudes towards school, and the students' better achievement. Other studies confirm these findings, showing other important connections between family factors and students' ability, or students' proficiency. For instance, Wisconsin's Status Attainment model [Sewell, Portes &Haller, 1969], postulates the existence of indirect effects of family structure on status attainment, such as the influence of significant others, and of students' educational and occupational expectations. Yet, there are studies that emphasize the importance of the so called "peer effect" on students achievement, i.e., being in a school where great part of the students have higher socio-economic level, and are academically motivated, has a strong effect in the students' academic achievement. The use of multi-level analysis for the SAEB data, discussed early in this paper, corroborates these high effects of school

composition. According to the results of the path analysis presented here, the peer effect (here assessed as the effects of school mean economic resources, and mean attitude towards school) affects proficiency mainly through the measure of "past proficiency", or retention. These results can be interpreted in the following way: schools with higher mean economic resources and higher mean attitude towards school are more likely to have students with lower retention levels, i.e., students' that are in the expected age-grade level. Being with peers of the same age, and never having experienced failure, are factors that influence students' achievement directly and indirectly (through having more participative parents and more positive attitudes towards school). This structure of effects can be observed for boys and girls, although some effects are significantly higher or lower for each sex. This fact cannot be ignored, or we would be running the risk of neglecting relevant gender differences in the way family factors operate, that may account in a certain level for the observed difference.

This study can be improved by using the other variables related with academic achievement such as teacher, school context, classroom context and the community around the school or shortly the environment related factors.

BIOGRAPHY

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