Effects of Demographic and Affective Characteristics on Physics Achievement: A Structural Equation Modeling Approach[*]

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ABSTRACT

In this study the process of how socioeconomic status, specifically parents' education, income and students' prior learning affect the children's academic achievement and affective characteristics (attitude and self-efficacy) were examined. The study was performed on 205 17-18-year-old students. Parents' years of schooling was also found to be statistically important as socioeconomic factor to be considered in both policy and research on school-age children. It is found that parents' education and students' prior learning have direct effect on achievement and affective characteristics. On the other hand, family income has indirect effect on achievement and affective characteristics through student prior learning.

Key Words: Structural Equation Model; Physics Achievement; Parents' Education; The Level of Income.

INTRODUCTION

Influence of Parents Education, Household Income, and students' prior learning

The literature on achievement has consistently shown that parent education is important in predicting children's achievement (Klebanov, Brooks-Gunn & Duncan, 1994; Haveman & Wolfe, 1995; Smith, Brooks-Gunn & Klebanov, 1997). While the majority of the literature on parents' education pertains to the direct, positive influence on achievement (Jimerson, Egeland & Teo, 1999; Kohn, 1963; Luster, Rhoades & Haas, 1989), the literature also suggests that it influences the beliefs and behaviors of the parent, leading to positive outcomes for children and youth (Eccles, 1993). For example, Alexander, Entwisle, and Bedinger (1994) found that parents having moderate to high income and educational background held beliefs and expectations closer to the actual performance of their children than those of low-

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income families do, low-income families instead had high expectations and performance beliefs that did not correlate well with their children's actual school performance. Halle, Kurtz-Costes and Mahoney (1997), using a sample of low-income minority families, also found that mothers with higher education had higher expectations for their children's academic achievement and that these expectations were related to their children's subsequent achievement in math and reading. Research on parenting also showed that parent education is related to a warm, social climate in the home. Klebanov et al. (1994) found that both mothers' education and family income were important predictors of the physical environment and learning experiences in the home but that mothers' education alone was predictive of parental warmth. Likewise, Smith et al. (1997) found that home environment mediated the association of family income and parents' education with children's academic achievement. The mediation effect was stronger for maternal education than it was for family income. Thus, these authors suggested that education might be linked to specific achievement behaviors in home. Corwyn and Bradley (2002) also found that maternal education had the most consistent direct influence on children's cognitive and behavioral outcomes with some indirect influence through a cognitively stimulating home environment.

Another effective factor in the student's achievement, which is also the main foundation in constructive learning, is the initial knowledge that students have had. Zeegers (2004) conducted a path analysis investigating some 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, and found that they had an impact on the student's achievement. For that purpose, a study has been performed 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.

Influence of Affective Characteristics

Besides these topics, some researchers investigated the influence of the affective domain on achievement in addition to cognitive domain. There were two distinct arguments for the importance of the affective domain according to Schibeci (1983). The first was the idea that affective factors and achievement were inextricably linked, and as a result, the person interested in students' achievement in cognitive domain must also be concerned with affective factors. Schibeci opposed this argument by mentioning the meta-analysis conducted by Willson (1983). Results of the meta-analysis indicated that the relationship between attitude and achievement in science is not particularly strong. If one accepts that affective factors consist of only attitudes, what Schibeci stated could be acceptable. However, variables such as self-esteem, academic self-concept, interest in science, values, etc., are also considered as affective factors (Simpson & Troost, 1982). The second argument for the importance of the affective domain is that controlling affective factors is a more important goal of education than controlling cognitive factors. Payne (1977) explained this second position, and argued that affective variables (a) influence a person's ability to participate effectively in a democratic society, (b) are necessary for a healthy and effective life, and (c) interact with occupational and vocational satisfaction. Thus, even if they are not more important from cognitive factors, affective factors are still as important as cognitive factors.

Physics Attitude

In the studies conducted about the attitude towards the physics; Tamir, Arzi and Zloto, 1974; Redford, 1976; Maskan and Güler, 2004 and Gönen, Kocakaya and İnan, 2006 have

examined the effects of attitude towards physisc on students' physics achievement in a detailed manner; while Tamir and his friends (1974) have only emphasized the factors influencing the attitude towards physics. Redford (1976) on the other hand has analyzed the school principles', counselors' and physics teachers' attitudes towards physics in high school curriculum. In addition to these, Germann (1988), Hough and Piper (1982) and TIMSS (Third International Mathematics and Science Study) (1999) have investigated the relationship between achievement in a science course and the attitude towards science and have reached the conclusion that there is a positive relationship between the students' attitudes and their achievements. Additionally, Schibeci and Riley (1986) have tested two different models to answer the question 'Does the attitude affect the achievement or is it vice versa?' and concluded that attitude affects achievement. While highlighting that there is a correlation between the attitude and achievement in their study, Oliver and Simpson (1988) have also pointed out that this relationship explained the large proportion of the variance; Weinberg (1995) has confirmed that this relationship between the attitude and achievement has been in the positive direction but not, at a high level.

Wilson (1983), in the meta-analysis, had studied with students in different educational levels, starting from elementary school continuing on towards the college, and had examined the relationship between the attitude towards science and achievement in science and confirmed that the mean of the relationship between the attitude towards science and achievement in science was 0.16 and as the education level increased, the attitude also increased. He also cited that there was a higher correlation for attitude influencing achievement than for achievement influencing attitude. Weinberg (1995), in the meta-analysis, stated that the relationship between attitude towards science and achievement in science was generally at a medium level and when a comparison was made between female and male students, males had more positive attitudes than females do. Third International Mathematics and Science Study (TIMMS), which is much more in-depth, has researched the attitudes of the 8th grade students in 38 countries towards physics, chemistry and biology, which are sub branches of the science course (Martin, Mullis, Gonzales, Gregory, Smith, Chrostowski, Garden & O'Connor, 2000). The science attitudes, according to the results of the TIMMS (1999), have been examined in two sub categories as usefulness of the science and enjoyment of the science and it has been stated that there is a very clear and positive association between the attitude towards the science and attitudes towards the sub branches of the science. Together with this, it has been established that the students' attitudes towards these sub branches in countries where the science course is separated into the sub branches as physics, chemistry and biology are lower than the students' attitudes in the countries where the science course is programmed as a whole and not divided into the sub branches.

Physics Self-Efficacy

Another important affective characteristic influencing the achievement in educational environment is the self-efficacy perception. The self-efficacy is an important concept, which is prominent in the Social Learning Theory (Social Cognitive Theory) of Bandura and it is the self-judgments of the individuals about how well they would perform the acts that are necessary to cope with the probable circumstances (1977, 1982 and 1995). Gibson and Dembo (1984) have stated that in case the individuals believing that they shall not be able to perform certain activities, they shall either never perform the necessary behavior or that even if they perform that behavior, the behavior shall not remain constant.

Bandura (1995) has stated that there are four main resources of the self-efficacy beliefs and these are; absolute and precise experiences, indirect lives provided by social models,

verbal persuasion and physical and emotion condition of the individual. The most effective of these resources is the personal experiences of the individual. The beliefs of the self-efficacy affect the goals that the people set for themselves, how much effort they shall put in order to reach these goals, how long they shall face the difficulties they have been encountering in reaching these goals and their reactions against failure. Together with not having many extensive studies that tackle the self-efficacy perception per se; the studies performed have been conducted over lower classes with low achievement level (Schunk, 1994; Schunk & Pajares, 2002). The studies that have been concerning the self-efficacy up to today have shown that the self-efficacy increases as the grade level goes up. Shell, Colvin and Bruning (1995) have determined that the self-efficacy of the 4th grade students have been lower than the 7th grade students and the self-efficacy of the 7th grade students have been lower than the 10th grade students for reading and writing (see Zimmerman & Martinez-Pons, 1990, for similar findings).

The studies performed in the field of education concerning the self-efficacy beliefs are generally handled in three categories. These are the researches associated with the effects of the self-efficacy beliefs on the academic achievement and performance, researches addressing the effects of the self-efficacy beliefs to area selection of expertise and preferences as occupation and topics and finally the researches addressing the self-efficacy beliefs of the teachers and applications that have been actualized in the education and the relation between different student products as topic (Pajares, 1997). Multon, Brown and Lent (1991) have examined the relationship between the self-efficacy perception and academic products in a meta-analysis and found that this relationship is higher in students who are at high school and university levels rather than the elementary school students. Furthermore, they reach to a conclusion that the self-efficacy perception explains the 14% of the variance of the academic performance.

In this study, it is decided that physics attitude and physics self-efficacy which is being used and analyzed separately as affective characteristics in educational field, using attitude and self-efficacy together in one analysis help and contribute more meaningful results to educational area. For that reason physics attitude and physics self efficacy were selected as affective characteristics of this study and analyzed under one category.

Also, due to the fact that the study is executed by receiving assistance from a computer, the students' attitudes towards the computer has also been handled as a variable and these variables' effects, both directly and over one another, to the students' achievements in the physics course have been analyzed by using the structural equation model.

Thus, the purpose of this study is to address these issues by testing a cross-sectional model of how parent education and family income influence child development (both achievement and affective characteristics) during middle childhood and high school at age 12-18 (see Figure 1 for a conceptual model). Even though causality cannot be tested in a cross-sectional model, structural equation modeling can determine whether a model provides a plausible fit to the data. If it does, then one is justified in gathering and testing longitudinal data. The model posited here suggests two specific hypotheses: (a) Parents' education and family income influence children's elementary school achievement (ESA) directly, parents' education, family income and ESA has direct effect on both Affective characteristics (AC) and Physics Achievement (PA), and AC has direct effect on PA. (b) Parents' education and family income, at first, influence children's AC and PA directly and secondly affect indirectly through ESA and influence PA through AC. For this aspect, ten hypotheses were constructed for model. The research is guided by a combination of family process models (Conger, Ebert-Wallace, Sun, Simons, McLoyd & Brody, 2002; Corwyn & Bradley, 2002; Linver, Brooks-Gunn & Kohen, 2002; Mistry, Vandewater, Houston & McLoyd, 2002) and socialization

models of achievement that focus on the role of parents' beliefs and behaviors as indirect links between socioeconomic status (SES) and child outcomes (Eccles, 1993; Guo & Harris, 2000). Even though the research on parent behaviors as mediators of socioeconomic influence is growing (Guo & Harris, 2000), few researchers have examined the parent psychological factors (e.g., parental beliefs) that might influence parents' behaviors. By combining these two models, researchers will be able to test their predictors about the pathways through which socioeconomic indicators influence children's achievement. To achieve this goal, we have included constructs of parent education, household income, and child's prior learning as predictors of children's academic achievement.
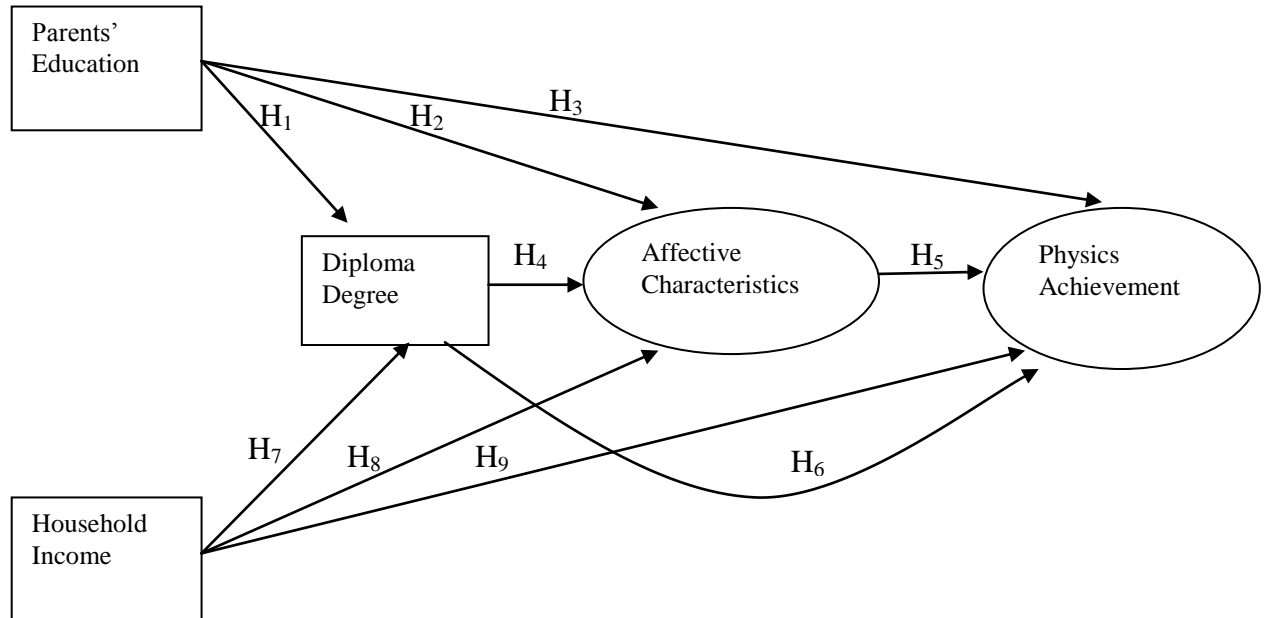
Figure 1. *Model of possible relationships between physics and related affective characteristics*

Hypothesis

H_0: (Null hypothesis) Influence of cause variables on effect variables is not significant.
H_1: There is significant effect of Parents' education on Diploma Degree.
H_2: There is significant effect of Parents' education on Affective Characteristics.
H_3: There is significant effect of Parents' education on Physics Achievement.
H_4: There is significant effect of Diploma degree on Affective Characteristics.
H_5: There is significant effect of Affective Characteristics on Physics Achievement.
H_6: There is significant effect of Diploma degree on Physics Achievement.
H_7: There is significant effect of Household Income on Diploma Degree.
H_8: There is significant effect of Household Income on Affective Characteristics.
H_9: There is significant effect of Household Income on Physics Achievement.

METHODOLOGY

   a) Participants

   The study has been conducted with 205, 17-18 year-old students (158 male, 47 female), who receive 2nd and 3rd grade education in four different high schools in the city center of Diyarbakır/TURKEY during the academic year of 2006-2007. A science high school (this school accept students with central exams), an anatolian high school (this school accept students with central exams), a vocational high school and a public high school have been determined as the schools that are going to be studied in the research's scope.

Sample size of the study accepted adequate. Because, in the literature, sample sizes commonly run 200 - 400 for models with 10 - 15 indicators. One survey of 72 SEM studies found the median sample size as 198. Loehlin (1992) recommends at least 100 cases, but preferably 200. Hoyle (1995) also recommends a sample size of at least 100 - 200. Kline (1998) considers sample sizes under 100 to be "untenable" in SEM. Schumacker, Randall and Lomax (2004) surveyed the literature and found sample sizes of 250 - 500 to be used in "many studies" and "numerous studies ... that were in agreement" that fewer than 100 or 150 subjects was below the minimum. A sample of 150 is considered too small unless the covariance coefficients are relatively large. With over ten variables, sample size under 200 generally means parameter estimates are unstable and significance tests lack power. A practical rule found in the literature is that sample size should be at least 50 more than 8 times the number of variables in the model. Another practical rule, based on Stevens (2002), is to have at least 15 cases per measured variable or indicator. Bentler and Chou (1987) allow as few as 5 cases per parameter estimate (including error terms as well as path coefficients) if one has met all data assumptions.

b) Procedures and Measurements
In this study carried on an experimental design, it was observed the effect of constructivist learning theory on the electrostatic achievement of a student. During the study for four weeks (per week 2 hours) electrostatic subject was processed according to constructivist learning theory and by computer aided [Please look at Kocakaya (2008) to detailed information about application of constructivist learning theory]. At the end of the study when measuring students' achievement, an electrostatic achievement test that consists of 30 multiple – choice question was applied. Then again a physics concept test consisted of 33 propositions of misconception was applied for understanding to what degree the students comprehend the concepts within the subject at the end of the study.

Two main headgear located in high school physics curriculum were took into consideration when the students' achievement was examined. Electricity headgear was selected in the curriculum consisted mechanics and electricity. To enable a meaningful comparison of electricity, "electrostatics" topic was selected for instructions, for it is being conceptually hard to understand and in the same time suitable for simulation in computer environment. One of the hardest areas of the electrostatics for students is the difficulty to visualize the electrical forces and the related mathematical terms such as ($F \sim 1/r^2$) (Scott & Risley, 1999). They have also problem in visualizing the movement and the direction of an electrical charge (positive or negative) in an electrical field. By providing such programs to students, it was aimed to help better understand the electrical processes without entirely depending on the mathematical definitions.

Questions of the achievement test developed by Gönen and Kocakaya (2005) have been grouped according to the knowledge, comprehension and application levels of the cognitive domain in accordance with Bloom taxonomy. Eight of the questions in the test, are at the knowledge level and 15 of the questions are at the comprehension level and 7 of the questions are at the application level. In order to provide validity of the achievement test was referenced in to opinions two physics experts and three experienced physics teachers. The achievement test was revised in line with the recommendations experts and teachers. The reliability coefficient of the test has been determined with the method of dividing the test of Spearman-Brown into two halves of the equal value ($\alpha=0,896$). The coefficient of this value means used achievement test results are high reliable.

Each one of this 33 propositions in the concept test consisted misconceptions existed commonly on physics students in the world (Url-1 and Url-2). In this test, students were

wanted to give a judgment as true or false for the given proposition. The reliability coefficient of the test has been determined with the method of dividing the test of Spearman-Brown into two halves of the equal value (α=0,670). The coefficient of this test means used concept test results have acceptable reliability value. To determine the validity of this test, opinion of two physics experts was asked and in accord with these experts' opinion, it is decided that propositions of these test can reveal students' misconceptions on this subject.

Total scores received by students at both physics achievement test and physics concept test have been calculated by appointing score of "1" to the each correct answer and appointing score of "0" to the each wrong answer. Also, students have been told not to place any marks next to the questions that they have had no opinions on what their answers might have been. Due to the fact that a score of "1" is appointed to the each correct answer in the achievement and concept tests, the highest score that a student may receive in the tests is as high as the number of questions found in the tests.

In applied questionnaire for determining demographic characteristics of the students; gender, educational level of father and mother, income of family and elementary education diploma degree were asked.

The method specified below has been used in order to make an analysis in the demographic characteristics. For the illiteracy status in the families' education level has received the code "1", literacy has received the code "2", graduate of an elementary school has received the code "3", graduate of an high school has received the code "4" and graduate of a university has received the code "5". In the portion that contained the information about the family income status; status in the range between \$0-400 have received the code "1", \$400-800 has received the code "2", \$800-1200 has received the code "3", \$1200-1600 has received the code "4" and families in the range of \$1600 and above have received the code "5".

Once and for all, students' affective characteristics are investigated besides cognitive characteristics. For this purpose, a physics attitude scale made of 5 point Likert type of 24 propositions developed by Özyürek and Eryılmaz (2001) (by changing the "indecisive" proposition in form of "partially agree"), a self-efficacy perception scale towards the physics course made of 5 point Likert type of 11 propositions developed by Maskan (2006) and a computer attitude scale made of 5 point Likert type of 42 propositions developed by Deniz (1995) were used on each of the group formed. Cronbach-alpha values determined for the scales respectively as 0.943 for physics attitude scale, 0.800 for self-efficacy perception scale and 0.923 for computer attitude scale. Those three values show that used scales have high reliability coefficients.

While a scoring method of increasing from 1 to 5 was being used for the positive propositions in the 5-point Likert type scales a scoring method of decreasing from 5 to 1 has been used in the negative propositions. Propositions for the attitude scale towards physics course were in form of "Strongly Disagree, Disagree, Partially Agree, Agree, Strongly Agree", propositions for the attitude scale towards computer were in form of; "Not At All Agree, Some-What Agree, Agree, Very Much Agree, Totally Agree", propositions for the self-efficacy perception scale towards the physics course were in form of; "Never, Rarely, Sometimes, Mostly, Always".

c) Analysis Plan

To test our hypothesis we used the Amos 16.0 program for the analysis of moment structures (Arbuckle & Wothke, 1999) to estimate our structural equation model (SEM). Amos uses a maximum likelihood method for obtaining estimates of the parameters. It allows a robust analysis when data on some measures are missing (Arbuckle & Wothke, 1999;

Byrne, 2001). We measured the goodness of fit of the models with four generally accepted indices of fit. In general, the overall fit of a SEM is determined by the chi-square statistic that tests for comparability between the proposed model and the independence model, in which constructs are assumed to be unrelated (Bollen, 1989). This statistics, however, can be influenced by large sample sizes, and thus, other goodness of-fit indices are used to provide additional information on the adequacy of fit of the proposed model (Byrne, 2001). There is a broad array of indices that are calculated by the Amos program, but recent research (McDonald & Ho, 2002; Mels, 2004) recommended that three of these indices (comparative fit index [CFI], root-mean square error of approximation [RMSEA], and goodness of fit index [GFI]), along with chi-square information, are adequate for examining the consistency of fit. The chi-square ratio (x^2/df) statistics, which adjusts for the chi-square statistics' sensitivity to sample size and the complexity of the model (Byrne, 2001), is examined in the present research. In general, chi-square ratios between 1 and 3 indicate good model fit (Arbuckle & Wothke, 1999). Three other indices that have been shown to be good indicators of fit, CFI, RMSEA, and GFI are also reported for the models. Models are considered a good fit if CFIs and GFIs are greater than .90 and RMSEAs are less than .05 (McDonald & Ho, 2002; Mels, 2004).

FINDINGS

Descriptive statistics (means, standard deviation, ranges, and correlations) for the variables in this study are shown in Tables 1 and 2. The correlations show that ESA and PA have strong relation with all variables except CAS, household income has significant effect on PA and PCA, and parental education has significant effect on PA, for the affective domain; PAS and PSEP has significant relation on the students' achievement.

Table 1. *Means, Standard Deviations, Sample Size, and Range for All Model Indicators*

Variable	M	SD	N	Range
Demographic characteristics				
Family Income (FI)	2,04	1,00	205	1-5
Parent Education (PE)	3,32	1,06	205	1-5
Elementary School Achievement (ESA)	4,29	,75	205	1-5
Affective characteristics				
Physics Attitude Scale (PAS)	3,37	,83	205	1-5
Physics Self-Efficacy Perception (PSEP)	3,24	,67	205	1-5
Computer Attitude Scale (CAS)	3,79	,66	205	1-5
Achievement				
Physics Achievement (PA)	17,90	1,24	205	0-30
Physics Concept Achievement (PCA)	11,62	,51	205	0-33

Table 2. *Correlation Matrices for Study Variables*

	ESA	PE	FI	PA	PSEP	PAS	CAS
PE	,141*						
FI	,348**	,550**					
PA	,776**	,188**	,312**				
PSES	,321**	-,098	,061	,385**			
PAS	,280**	-,070	,059	,366**	,625**		
CAS	,023	,060	,090	,017	,319**	,226**	
PCA	,199**	,136	,151*	,222**	-,030	,053	-,050

*   Correlation is significant at the 0.05 level (2-tailed).
**   Correlation is significant at the 0.01 level (2-tailed).

Structural Model

The results from the SEM structural models support our specific hypotheses partly. End of the analysis, in our 9 hypothesis H_1 to H_9, some hypothesis was rejected and Null hypothesis was accepted (P>0,05). These rejected hypotheses are;

H_1: There is significant effect of Parents' Education on Diploma Degree.
H_8: There is significant effect of Household Income on Affective Characteristics.
H_9: There is significant effect of Household Income on Physics Achievement.

Our structural model fits fairly well ($x^2/df \leq 1.23$, CFI $\geq$ .99, GFI $\geq$. 97, RMSEA $\leq$ .034) and a large percentage of the variance is explained (R^2 = .69) for child's achievement (Figure 2.). Education has direct effect on affective characteristics (β= -.16, P<.05) and achievement (β= .12, P<.01) but parent education has no significant effect on ESA (P>.05). ESA has direct effect on affective characteristics (β= .39, P<.001) and achievement (β= .71, P<.001). Family income (household income) has direct effect on ESA (β= .35, P<.001) but has not direct effect on affective characteristics and achievement. Income was related indirectly to child achievement through ESA (β= .35, P<.001) and through affective characteristics (β= .21, P<.001).
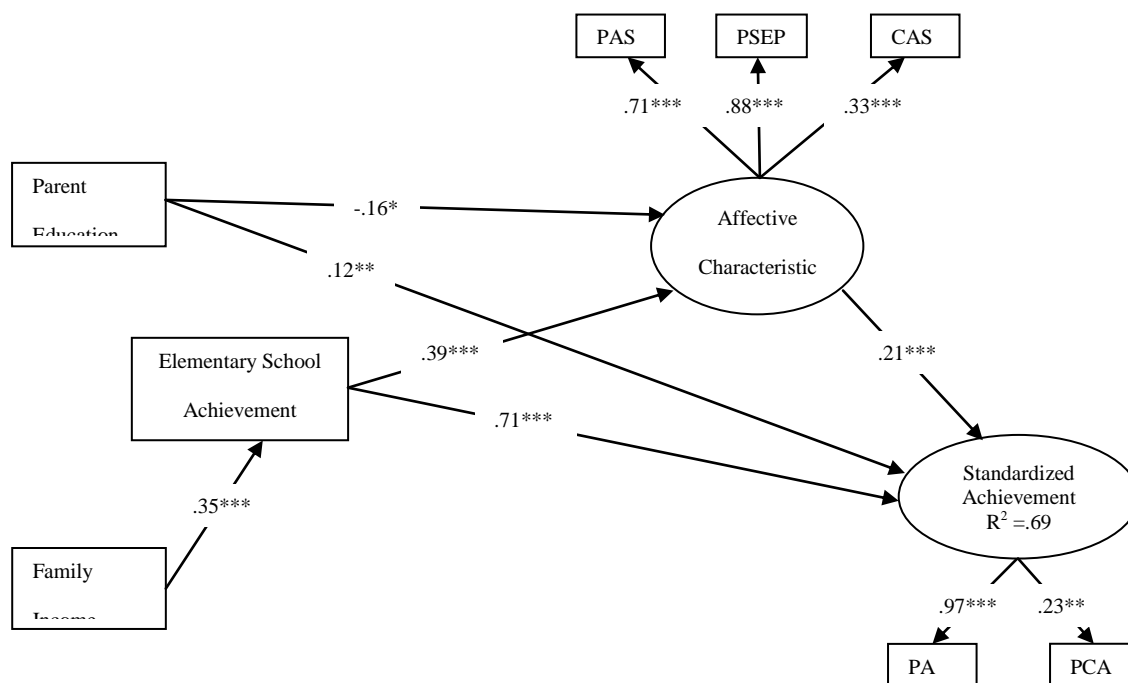
Figure 2. *Structural model*
PA = Physics Achievement, PCA = Physics Concept Achievement, PAS = Physics Attitude, PSEP = Physics Self Efficacy Perception, CAS = Computer Attitude. Model Fit Statistics: x^2=19.766, *df*=16, $x^2/df \leq$ 1.23, CFI $\geq$ .99, GFI $\geq$. 97, RMSEA $\leq$ .034. *P< .05. **P< .01. ***P< .001.

Standardized Direct, Indirect, and Total Effects for all variables used in the model were shown in Table3.

Table 3. *Standardized Direct, Indirect, and Total Effects for All Variables in the Model.*

Predictor	Dependent variable	Total effect	Direct effect	Indirect effect
Parent education	ESA	.000		
	Affective	-.16	-.16*	
	Achievement	.09	.12**	-.03
Family Income	ESA	.35	.35***	
	Affective	.14		.14
	Achievement	.28		.28
ESA	Affective	.39	.39***	
	Achievement	.79	.71***	.08
Affective	Achievement	.21	.21***	

Note. Significance tests are only reported for direct effects. Dashes represent empty cells or no information because the paths were not tested in the model.
*p< .05. **p< .01. ***p< .001.

DISCUSSION

This study examined the family processes that might indirectly link parent education and other family background indicators, such as income, with child achievement. This indirect link was hypothesized to work through the elementary school achievement (diploma degree) and affective characteristics (attitude and self efficacy). The hypotheses that parents' education and household income influence child achievement indirectly through its impact on the students' diploma degree and the affective characteristics were partly supported. For the results; parental education has indirect effect on achievement through affective characteristics but not on the diploma, and household income has indirect effect on achievement through diploma but not on the affective characteristics. In addition to these, parent education has no direct effect on elementary school achievement, and household income has no direct effect on affective characteristics and achievement. For those reasons, the hypotheses H_1, H_8, and H_9 were rejected.

For this sample, parents' education had both a direct and indirect relation to children's academic achievement. The results for the SEM model suggest that the association between family SES characteristics and children's academic achievement is not fully explained by the indirect paths included in our model. In spite of a moderate relation between parent educational level and elementary school achievement, analysis made with Amos 16.0 program showed that their effects in the model were insignificant so they were off from structural equation model (figure 1).

Besides there was a significant relation between household income and students' achievement on PA and PCA, the effects of these were off from the model as the reason mentioned above. Although it has been shown in this study that income has not any effect on students' achievement, Gutman and Eccles, (1999)'s previous research on low-income samples has suggested that there is little difference in how these variables might influence children's academic achievement. The present research used a moderate broader national sample and found some no important differences in the paths linking education and income to children's academic achievement. To truly understand how family income ultimately impact child development, it will be important in future research to replicate this finding as well as to examine how these processes might differ with broader sample. Second, the results suggest that the amount of schooling that parents receive influences how they structure their home

environment as well as how they interact with their children in promoting academic achievement. In our study, two achievements for students were investigated. The first is the achievements in primary education during 3 years and the second is obtained physics achievement at the end of the study. According to obtained data, parents' education has not any significant effect on elementary school achievement (12-15 year olds) but has significant effect on PA (17-18 year olds).

This finding indicates that the economic difficulties, which certainly still exist many in Turkey, do not necessarily constrain academic development. It is possible that parents as "co-teachers" in the home may find a better psychological balance of stimulation and demand for their children when they were successful in their past academic achievements. Although poverty certainly is a major threat for child development, a closer look at the underlying mechanisms may help explain why so many poor children perform well in school despite restricted material resources. If parents are successful in providing an emotionally stable and stimulating environment, the negative effects of financial restrictions can be minimized. Although poverty has an important relation to developmental outcomes in the early years of development, it may have less influence on outcomes during middle childhood and adolescence. During these years, parents' education may help parents be more efficient teachers at home because they are more likely to know something about what the children are being taught and thus able to help with homework and to provide appropriate cognitive stimulation when children are not in school (Alexander et al., 1994).

Finally, there are notable effects of the affective characteristics on Childs' outcomes in the model. For the model, affective characteristics used in this study explain .15 of variance and affect the achievement significantly (p<.001 and β=.21).This result is supported with some literatures. For examples; the meta-analysis conducted by Willson (1983) indicated that overall relationship between attitudes toward science and science achievement was .16, with differences among elementary, junior high, senior high, and college subjects. Moreover, the mean correlation of attitude and achievement in physics was .18.Willson reported that at senior high and college levels, there was a higher correlation for attitude influencing achievement than for achievement influencing attitude, but at no levels these results were statistically significant. At the college level, correlation between achievement and attitude was 0.02 (for 4 studies) and correlation between attitude and achievement was .20 (for 14 studies). An extensive research project, Third International Mathematics and Science Study (TIMSS) explored eighth-graders' attitudes towards different branches of science (biology, chemistry, and physics) in 38 countries (Martin et al., 2000). Overall results and results of many countries showed that there was a clear positive association between attitudes towards different branches of science and science achievement.

Even though this study has many interesting findings to contribute to the literature, there are features that limit the generalizability of these findings. One of the strongest limitations is the use of cross-sectional data to test process models. In an attempt to get a more heterogeneous, representative sample that was not biased in terms of income or region of the country, a national dataset was used. Unfortunately, this dataset only had information from parents and children at one time point. Thus, it was not possible to examine these processes longitudinally, which would have provided a better test of our causal hypotheses.

Consequently, this study has demonstrated that the relation of parents' educational attainment to children's academic achievement is indirectly related through students' attitudes and self-efficacy perceptions. Parents' educational attainment has been found to be one of the most critical variables in the mortality of children across the world (Desai & Alva, 1998; Elo & Preston, 1996) and seems to be a major variable in children's well-being in general (Chen, Matthews & Boyce, 2002). Furthermore, researchers and policymakers should examine the

mechanisms that might be leading to these effects. Even though education is by no means a quick intervention, it is more permanent and perhaps has more impact on the home environment across youth development than what might be expected from temporary increases in income. This is particularly important for current welfare policy, where little incentive or compensation is given to those who want to obtain additional education. Some researchers would suggest that it is hard to intervene on parents' educational attainment (Lee & Croninger, 1994). Research using experimental intervention studies; however, suggests that it is possible to make a difference even from small increases (Magnuson & McGroder, 2001). The foundations of an intervention do not exist in Turkey, where education is available to all citizens. What would be needed are additional buildings or agencies but the review of programs and policies that might be leading disadvantaged youth to leave school early and not return or acquire an equivalent degree. If parents of children are well-educated, it might lead to better outcomes for children. Therefore, parents should be given special attention to education.

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