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Research Paper

Effect of ICT Use, Parental Support and Student Hindering on Science Achievement: Evidence from PISA 2018

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ABSTRACT
We aimed to examine the effect of ICT use, parental support and student hindering on science achievement in Turkey, USA and South Korea with using PISA 2018 data. PISA is one of the biggest international assessment study aiming comparison of students' academic capabilities in science, mathematics and reading among participant countries. For this purpose, we classified variables related to student -ICT use out of school for leisure, ICT use in classroom, perceived family support, students' hindering behaviors, gender and ESCS on student achievement- as (i) student level and (ii) school level. Approximately 710.000 students representing nearly 32 million students from 79 participating countries completed the PISA 2018 assessment in all over the world. Number of participants were 6890 in 186 schools for Turkey, 4838 in 164 schools for USA and 6650 in 188 schools for South Korea. We used a two-level hierarchical linear model (HLM) to determine the effect of parents' emotional support, student hindering behavior, ICT use in classroom and ICT use out of school for leisure on science achievement. Two students' background variables (gender and economic, social and cultural status) were controlled for student levels. Two level HLM results indicated that gender of the students has a significant effect on science achievement in Turkey but no significant effect in USA and South Korea. Additionally, family socio-economic status had a significant positive effect on students' science achievement in all three counties. We also found that in all three countries, family support had a positive influence on science achievement. Results indicated that student-hindering behavior had a negative effect on science achievement for all three countries. In USA, an increase in ICT usage had a very strong negative effect on science achievement. On the contrary, ICT usage out of school for leisure had a positive effect on science achievement in Turkey. There was no significant effect in South Korea.

INTRODUCTION

A great majority of contemporary studies has been focused on school improvement and effective schools since Coleman report (Coleman et al., 1966). Previous studies for the past quarter-century have clearly suggested that school improvement took a very important role to enhance student learning and their academic achievement (Bryk, Sebring and Allensworth, 2010; Gore et al., 2021; Hallinger and Heck, 1996). Additionally, international studies such as Trends in International Mathematics and Science Study (TIMSS), Programme for International Student Assessment (PISA), Progress in International Reading Literacy Study (PIRLS) tried to reflect on student achievement by comparing nations' educational systems.

Drawing upon the available literature, we know that increasing student achievement is due to many school level factors such as school leadership (Goddard et al., 2019; Özdemir and Yalçın, 2019; Sebastian, Huang and Allensworth, 2017), teacher collaboration (Çoban, Özdemir and Bellibaş, 2020; Goddard et al., 2015), school climate (Hallinger and Murphy, 1986; MacNeil, Prater and Busch, 2009). Besides this, studies indicate that some student level factors such as gender (Spinath, Eckert and Steinmayr, 2014; Voyer and Voyer, 2014), socio-economic status (Dumais, 2002; Johnson and Stevens, 2006; Şahin and Çoban, 2020), and family support (Spinath et al., 2014) play a vital role on student achievement. It is very difficult to reveal student achievement in all aspects within these complex variables. Limited research has been focused on complex multilevel models related with effect of student self-hindering, parental support, ICT use out of school for leisure, ICT usage in class, gender, and ESCS on student achievement. Hence, with the present study, we aimed to examine the impact of both student and school related variables on student achievement in three countries -Turkey, USA and South Korea- by investigating the relations among some critical phenomena for student achievement. Especially, the present study objected to provide which student related issues influences student achievement within and between schools according to PISA 2018 results.

We selected three countries Turkey, USA and South Korea from the PISA 2018 cycle. Of these countries, South Korea is in the upper row, United States is in the middle row, and Turkey is located slightly below the average in PISA ranking. In this research, we objected to see the variations in student achievement in three countries. Our findings could contribute the enriching knowledge

base in the context of student achievement in international level. It could also guide to countries in the process of developing educational policies and structures similar to those of Turkey, USA and South Korea.

Theoretical Framework

In the literature students' academic achievement is depend on various factors. These factors can be classified mainly into three groups: (i) student, (ii) school resources, and (iii) teaching and management processes in the school (OECD, 2005; Sarıer, 2016). Additionally, researchers claimed that economic social cultural status (ESCS) play a critical role in academic achievement of students (Coleman et al., 1966; Özdemir, 2019). Moreover, impact of some other variables such as students' ICT use (Çoban and Atasoy, 2019), their self-hindering behaviors (Şahin and Çoban, 2020), their families' support (Gonida and Cortina, 2014), and their gender (Spinath et al., 2014) was also stated in previous researches. In this study, we tested variables related to student such as ICT use out of school for leisure, ICT use in class, perceived family support, students' hindering behaviors, gender and ESCS in two levels as (i) student and (ii) school. Our theoretical model is designed to see how selected student-level and school level variables directly affect student achievement.

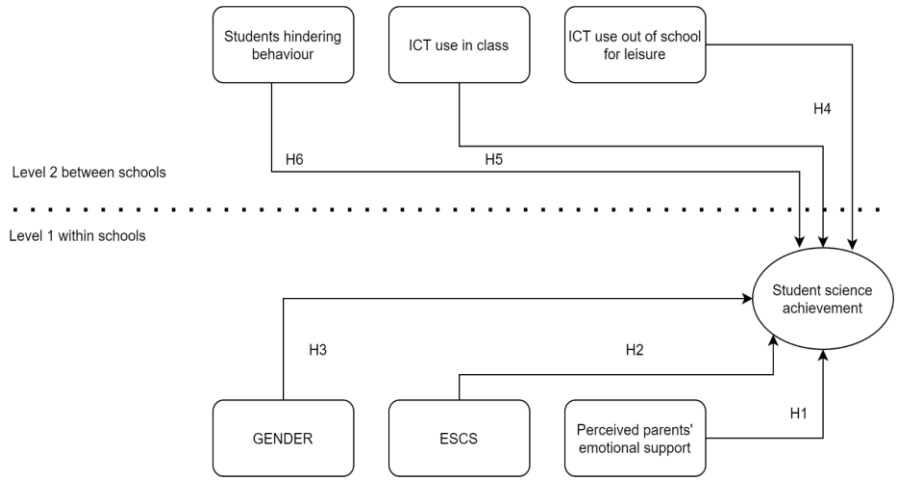

Figure 1. Model of the research

Note: ESCS: Economic, Social and Cultural Status

Figure 1 indicated the model in which we pointed out student achievement at two levels as within schools and between schools. At level 1, the variables of gender, ESCS, and perceived parents' emotional support were inserted to the model to explain the difference in achievement among students within a school. At level 2, ICT use out of school for leisure, ICT use in class and students' hindering behavior were included to explore the achievement gaps among schools. In the following part, the variables in the model were described respectively.

Perceived Parental Support for Learning

Effective school researchers and policymakers have long been focused on positive impact of parental support concerning educational outputs. They seem to have agreed that it is one of the critical components of student achievement in order to reach a successful education (Boonk, Gijselaers, Ritzen, and Brand-Gruwel, 2018). Recent findings revealed that schools require parental emotional support to raise children's interest, confidence, and achievement in school life (Dabney, Chakrverty, and Tai, 2013). A child's relationship with parents constitutes and shapes a basis for development of psychological, emotional, behavioral, social, and academic well-being of school engagement that remains relevant throughout school life. For this purpose, PISA has collected data focusing specifically on student's perceived parental support for learning since the 2015 cycle. In the related PISA frameworks, the term "perceived emotional parental support" was conceptualized as "support for children's educational efforts and achievements, encouraging them to overcome the difficulties in their school life and trying to make them confident" (OECD, 2018).

Research based on family level has firstly started with Coleman report. He has highlighted that parents' support have a great role in producing social capital. After Coleman's approach, considerable research evidence (Chen, 2008; Flynn, Felmlee, Shu, and Conger, 2018) has figured out that parents have a very important responsibility and play critical role in terms of promoting and strengthening their children's school life. As a context of role models, it can be stated that children's behaviors are obviously connected with parents' behavior without considering gender of children. Current researchers have highlighted that parental support is one of the determinants of student achievement. Eberbach and Crowley (2017) have pointed out that parents' emotional support is primary informal learning sources for children in science. Additionally, Hill and Taylor (2004) have underlined the gains to their children's social, emotional, and academic learning on educational support of parents at home and at school settings. Moreover, Çobanoğlu and Yurttaş-Kumlu (2020) have stated that mostly the parents had tendency to support their children's learning in the area of basic physical needs such as health, security, and nutrition than cognitive and emotional needs in the north region of Turkey.

Evidence also indicated that social support systems such as parental, teachers, and classmates support have an influence on students' emotional, cognitive, and behavioral engagement. This means that perceived parental support by students could help improve students' achievements, overcomes their difficulties and makes them more motivated (Gonida and Cortina, 2014), more confident, and more successful in their school life. Conversely, if parents neglect their children's educational life and disregard supporting them, student's academic achievement will probably decrease. Evidence has been found linked to long-term and a wider range of negative outcomes related to their offspring including risk-taking behavior and negative peer relationships based on lack of parental emotional support (Ehrlich, Dykas, and Cassidy, 2012). Children who have perceived parents' lack of interest (Aslanargun, 2007) may not be motivated emotionally and cognitively in school life. However, research evidence indicates that the relationship between parents and their offspring influence academic achievement bidirectionally. Therefore, we assume that there is a positive relationship between perceived parents' emotional support behaviors and their academic achievement (Hypothesis 1).

Economic, Social and Cultural Status (ESCS)

ESCS is defined as "the relative position of a family or individual in a social system in which individuals are ranked according to their access to or control over wealth, power, and status" (Willms and Tramonte 2015, p.201). The PISA ESCS term covers parents' educational attainment, their highest occupational status, income, and home possessions that contain measures of wealth, educational and cultural possessions, and the number of books available at home. Parent's perspectives on academic interest are varying with respect to social class according to some researches (Lee and Shouse, 2008) and socioeconomic and cultural level (OECD, 2019; Özdemir, 2019). Parental support and ESCS may be inextricably linked. Jeynes (2011) reported that the level and pattern of support may differ with parents' ESCS for various reasons. They highlighted that high-ESCS parents' personal effort, orientation and determination lead to academic and occupational success of their children. Evidence revealed that even though ESCS was formed in various ways historically, it had positive impact on student achievement in different situations. Previous findings also underlined that relationship between achievement of students and parents' supportive behaviors -parental learning support at home, parental academic emphasis, and communication between parents and teachers- became more effective for students whose parents were more educated, and who had higher income (Tan, Lyu, and Peng, 2020). Research also found that parents from lower ESCS backgrounds failed to support their students' academic achievement (Wang, Deng, and Yang, 2016). Hence, our hypothesis claims that there is a positive relationship between ESCS and science achievement (Hypothesis 2).

Gender

PISA assessments have also taken educational environments in consideration, as it allows researchers to find out how gender affects student achievement, particularly in different academic skills. Previous studies showed that while girls had higher scores in reading, boys had higher scores in mathematics and science (Ivinson and Murphy, 2003). However, although the distinction of achievement among these three-domain of skills has been accepted for years, some current studies have revealed that the difference is smaller than previously expected (Ivinson and Murphy, 2003; Salisbury, Rees, and Gorard, 1999). Some research outside the PISA demonstrates that girls perform better achievement than boys in general terms (Yu, Chan, Cheng, Sung, and Hau, 2006). Shortly, researchers must take gender into consideration in a country context when evaluating student achievement. Thus, we claim that female students are more successful than male students (Hypothesis 3) compared to their science scores.

ICT Use Out of School for Leisure

During the last two decades, the education policy area focusing on effective school and student achievement was confronted with a potentially useful revolution innovative and transformative based on the use of information and communication technologies (ICT). In this radical change landscape, ICT literacy has become an increasingly important topic on educational policy, reform, and research (ETS [Educational Testing Service], 2002; European Commission, 2013; Ferrari, 2012). The term ICT characterizes "one's efforts of the interest, attitude, and ability to appropriately use digital technology and communication tools to access, manage, integrate, and evaluate information, construct new knowledge, and communicate with others in order to participate effectively in the society" (Lennon et al., 2003, p.8). This definition contains some implications concerning effective school and specifically student achievement. This means that the use of ICT has substantial potential to impact how we think, teach, learn, interpret, and even evaluate a plethora of information.

Considerable amounts of international frameworks and theoretical knowledge pointed out that ICT use out of school for leisure matters a good deal to students' learning (European Commission, 2013; Ferrari, 2012; Gumus and Atalmis, 2011; OECD, 2015). The previous studies underlined that adolescents use ICT more often at home or out of school (Zhong, 2011), especially for entertainment and social interaction (play computer games and surf social media) rather than for educational purposes (Fraillon, Schulz, and Ainley, 2013). Researchers have reached paradoxically, on the one hand, evidence has found supporting a negative relationship between ICT and student achievement (Xiao, Liu, and Hu, 2019), on the other hand, a little evidence providing a positive effect (Skryabin, Zhang, Liu, and Zhang, 2015; Woessmann and Fuchs, 2005). However, its evidence [but not yet for each situation] has varied widely so far depending on different usage patterns. Nevertheless, some evidence indicated that ICT use out of school for leisure (at home and school outside) can be used to enhance learning-teaching environments in some developed countries (Carretero, Vuorikari and Punie, 2017; Fraillon, Schulz, Gebhardt, and Ainley, 2015). It is uncertain how it could be either the relationship between the ICT use out of school for leisure and student achievement. Therefore, our hypothesis is there is a direct and negative relationship between students' ICT use out of school for leisure and their academic achievement (Hypothesis 4).

ICT Use in Classroom

The adaptation and integration of technology into all facets of education (Bruniges, 2003) stems from the concern of how we can ensure students with a better instructional atmosphere, enthusiasm, and learning ambiance. In the literature, the term "ICT use in classroom" is often used interchangeably with "ICT integration" reflecting a change in pedagogical and educational approach to more central to student learning.

A potential advantage of various educational ICT resources is relevant to their positive effect on student learning, persistent motivation, and engagement, so they could be evaluated in the context of academic motivation to the learning environment and academic achievement (Mahdum, Hadriana, and Safriyanti, 2019; Uluyol and Şahin, 2016; Wentzel and Miele 2016). The use of ICT in the classroom could optimize students' learning, enhance their interest to the subject, engage them to learn (Atasoy, 2021; Ilter, 2009), trigger their creativity and passion (Pennington, 1996), promote learners' autonomy and centeredness (Murray, 2005) boost to teacher-student interaction and communication (Rank, Warren, and Millum 2011), and maximize student engagement (Atasoy, 2021) to the related learning process.

Drawing up to literature, conversely to the positive approaches, we have also reached that some researchers have struggled to find positive correlation and positive impact of ICT usage on academic performance was not certain. In this mean, some educational researchers have reported controversial results about the effect of in ICT use in school settings (Barrow, Markman, and Rouse, 2009; House, 2007; Cheung and Slavin, 2013; Lorenz, Eickelmann, and Gerick, 2015), and the effects of different media tools improving student learning (Mayer, 2009; Tamim et al., 2011). Fuchs and Woessmann (2004) stated that only one or a few increases in ICT indication(s) could not assure to enhance educational quality and academic performance. Mahdum, Hadriana, and Safriyanti (2019) have found that active involvement of students could lead to strengthen positive impact of ICT. In the OECD international survey' report, the inconsistency of correlational between these two parameters has been reflected as unexpected, undulated, elusive, and unforeseen evidence even as in schools that have invested in educational technology (OECD, 2015). Evidence of the Programme for International Student Assessment (PISA) has also revealed that those who sometimes use ICT at school perform better than those who never use them. However, Ainley, Enger, and Searle (2008) highlighted also that there is still no empirical explanation for positive impact of ICT use on achievement.

In previous studies, we have not clearly found a linkage or net direction between the impacts of ICT use on student performance. Although great attention and resources consumed for adaptation of ICT into education, its effect is not significantly determined on educational outcomes. In this perspective, we intended to test whether PISA 2018 results to what extend explain above evident debates in selected countries. However, we claim that the use of ICT on learning processes has a great potential to explain student achievement. Detailed and deeper research evidence is needed to agree to what extend ICT use in the classroom is most effective on student achievement. Hence, our hypothesis is the positive relationship between students' ICT use in the classroom and their academic achievement (Hypothesis 5).

Students' Self-Hindering

The term "self-hindering" reflects "one's efforts to protect or improve the self" (Thomas and Gadbois, 2007, p.102). Jones and Berglas (1978) underlined individuals actively blamed the conditions that had blocked their achievement and therefore they used self-hindering for self-protector. In other words, people who have persistently protective behavior against their selves show excellent performance less likely. People are socio-psychological beings and their situation in their societal life affects their psychological lives positively or negatively. Studies underlined that self-handicapping behavior appears in the situations such as delaying a specific task or activity, indicating abnormally high level of interest in activities in the unrelated task, omitting enough practice, and ignoring adequate nutrition and sleep (Barutçu Yıldırım, and Demir, 2019; Jones and Berglas, 1978). In educational system, we also saw these behaviors such as showing low performance, not focusing on classes, spending time on irrelevant efforts during the exam period etc. (Török et al., 2018).

Academic achievement and self-handicapping are two concepts that have negative relations with each other (Putwain, 2019; Şahin and Çoban, 2020). Şahin and Çoban (2020) found that there is a negative relationship between students' self-hindering behaviors and their academic achievement. As mentioned above, Jones and Berglas (1978) claimed that whenever students had possibility to face with failure, they have a tendency to produce excuses which externalize reasons of failure to other people to protect their selves. Additionally, self-handicapping behaviors are more widely observed in students who decide self-success with comparison with someone else (Yu and McLellan, 2019). Previous studies also underlined that negative relationship between academic success and self-handicapping become more significant when students had social acceptance and exam anxiety problems and the positive relationship between test anxiety and self-handicapping (Putwain, 2019; Thomas and Gadbois, 2007). Therefore, our hypothesis (Hypothesis 6) is there is a negative relationship between students' self-hindering behaviors and their academic achievement.

METHOD

Research Model

A relational screening model was used in this research. We explain how variables changes together and if it is, pattern of change is described (Daniel, 2012). We examined the effect of gender, ESCS, parental support, ICT use and student hindering behaviors on students' science achievement in Turkey, USA and South Korea according to PISA 2018.

Data and Sample

The data used in current study was obtained from PISA website (https://www.oecd.org/pisa/data/). PISA is a cross-national study aims to assess 15 years students' performance in math, science and reading. Turkey, USA and South Korea results of PISA 2018 has been evaluated in the current study. Approximately 710 000 students from 79 participating countries completed the PISA 2018 assessment in all over the world. For selected three countries, gender distribution of students and locations of schools are given in Table 1.

Table 1. Gender distribution of students and locations of schools for Turkey, USA and South Korea in PISA 2018.

Countries	Gender		School Location				
	Female	Male	Village	A small town	Town	A city	A large city
Turkey	3396	3494	3	11	53	50	69
USA	2376	2462	11	28	49	40	21
South Korea	3191	3459	4	10	19	71	82

Variables

A two-level hierarchical linear model was applied to determine the relationship between selected factors and science achievement. In the study, averages of 10 plausible values for science achievement score were used as dependent variables. There were two levels of independent variables; student and school level.

Student Level Variables:

Three variables were selected from student background questionnaire. Two variables were used as controlling variables in the model; economic, social and cultural status (ESCS) and gender. The third variable for student level was perceived parental support (EMOSUPS). Both ESCS and EMOSUPS are indices, which were derived from PISA 2018 student questionnaires. Indices summarize responses of series of related questions.

Gender:

Gender is dichotomous variable. Females are coded "1" and males are coded "0" as a dummy variable.

Economic, Social and Cultural Status (ESCS)

PISA index of ESCS was derived from three index variables related to background of family; parents' highest level of education (PARED), parents' highest occupational status (HISEI), and home possessions (HOMEPOS). PARED is computed from 4 items related with parents' education in student questionnaire; [ST005, ST006, ST007 and ST008]. HISEI is obtained from open-ended questions about both the student's father and the student's mother occupational status. HOMEPOS is a summary of index of all household and possession items including books. HOMEPOS is calculated from [ST011, ST012 and ST013] in the student questionnaire. In PISA 2018, these three standardized components of ESCS have equal weight. The final score for ESCS was transformed, student at OECD average is scored as 0, and 1 the standard deviation across equally weighted OECD countries.

Perceived Parents' Emotional Support (EMOSUPS)

The index of parents' emotional support was calculated from the responses in item ST123 in student questionnaire. In this item, following statements are asking to students; "My parents support my educational efforts and achievements.", "My parents support me when I am facing difficulties at school.", "My parents encourage me to be confident."
Scores in this index also again are standardized. Student with 0 score means he/she perceives emotional support from his/her parents on OECD average, positive values mean that students perceived higher levels of emotional support from their parents then OECD average.

School Level Variables:

The school level contains three variables, including student hindering behavior (STUBEHA), subject related ICT usage in lesson (ICTCLASS_SCH) and ICT use outside of school for leisure (ENTUSE_SCH).

Student Hindering Behavior (STUBEHA)

One of them is related with student hindering behavior (STUBEHA), which was derived from school questionnaire filled by school principal. This index item is calculated from responses of 5 items; student skipping classes, truancy, lacking respect for teachers, intimidating or bullying other students and using alcohol or illegal drugs.

Subject Related ICT Usage in Lesson (ICTCLASS_SCH)

This variable is calculated from one item in students' ICT familiarity questionnaire. In this questionnaire, IC 150 asked about subject-related use of various digital devices during classroom lessons (ICTCLASS). School mean was calculated from student responses and calculated mean was appointed as school ICTCLASS_SCH value at school level.

ICT Use Outside of School for Leisure (ENTUSE_SCH)

The indices were optional in students' ICT familiarity questionnaire, it derived from answers given to item IC008. The item asked how often 15-year-old students use various digital device for activities unrelated with lessons outside the school. Answers given to this question indicate frequency of ICT using for leisure (ENTUSE). Answers were summarized in an index which has a mean of 0 and a standard deviation of 1 across OECD countries. Since this item collected responses from student level, school mean was calculated from student responses to obtain score for each school. Value for each school was appointed as school ENTUSE_SCH value at school level.

DATA ANALYSIS

Two-level hierarchical linear model (HLM) was used to determine effect of parents emotional support, student hindering behavior, ICT use in classroom and ICT use out of school for leisure on science achievement. Two students' background variables (gender and ESCS) controlled for student levels. Both students and school weights were included in the model. HLM is generally preferred to investigate relationship between multiple independent variables at different levels on single dependent variables since it has some advantages for aggregated data structure with respect to traditional regression analysis (Raudenbush and Bryk, 2002). Problems like aggregation bias and underestimated standard error can more easily handle with HLM. In addition to these benefits HLM also eliminates the violation of assumption of independent observation (Lee, 2000). There are three main assumptions of HLM, which are linearity, normality and homoscedasticity. Linearity is a sign of relationship between variables and can be checked with drawing graph of variables. It was met since straight lines were observed in the analysis. Normality is another assumption, which assumes that error terms of both level 1 and level 2 distribute normally. It provided by investigation of plots and histograms. The last assumption is homoscedasticity and which assumes there are equal variances on groups in Level 2. Observed patterns of scatter plot indicated that the analysis did not violate this assumption.

The first step in HLM is testing the unconditional model which is one-way ANOVA with no covariates in order to determine how much variance can be attributed to within group (Level 1-Students) parameters and between group (Level 2- Schools) parameters (Willms and Smith, 2005). This model can provide baseline estimates of the variability in the outcome at Level 1 and Level 2 which can be used to test whether there is significant variance in the means (intercepts) in the sample of schools. The baseline model can also be used to compute the intraclass correlation coefficient (ICC), which is the proportion of the total variance in the outcome that is between Level 2 unit means. A significant ICC means there is significant clustering by group of individual-level values of the target variable and structure of data is suitable for two level analysis (Garson, 2014). According to Kreft and de Leeuw (1998) when the value of ICC is greater than .10, it is suggested to use the multi-level model. The ICC (ρ) for a two-level model can be described as the proportion of group-level variance from the total variance. In the formula, τ_{00} represents the variance at Level 2 and σ_e^2 represents the variance at Level 1:

$$\boldsymbol{\rho = \frac{\tau_{00}}{\tau_{00} + \sigma_e^2}}$$

After ICC calculated, variables at all two levels were added and full model was constructed. Since predictors were added for both Level 1 and Level 2, the model is called full random coefficient model. In this model, both the Level 1 intercept and the Level 1 slopes are predicted as random effect. The same model was implemented for three countries. The final two-level random coefficient models are as follows;

Level-1 Model:
$Y_{ij} = \beta_{oj} + \beta_{1j} * \text{Gender} + \beta_{2j} * \text{ESCS} + \beta_{3j} * \text{EMOSUPS} + r_{ij}$

Level-2 Model:
$\beta_{oj} = \gamma_{00} + \gamma_{01} * \text{STUBEHA} + \gamma_{02} * \text{ENTUSE\_SCH} + \gamma_{03} * \text{ICTCLASS\_SCH} + u_{oj}$

Where;
Y_{ij} is the science score for student i at school j.
β_{oj} is expected science score for a student in school j (mean for school j).
β_{1j} is expected difference between male and female in school j.
β_{2j} is expected slope of "ESCS" for students at school j.
β_{3j} is expected slope of "EMOSUPS" for students at school j.
r_{ij} is Level-1 residual error term associated with student i at school j.
γ_{00} is expected science score for a school (grand mean) .
γ_{01} is expected slope of STUBEHA for schools.
γ_{02} is expected slope of ENTUSE_SCH for schools.

γ_{03} is expected slope of ICTCLASS_SCH for schools.
u_{oj} is Level 2 random error term associated with school j.

RESULTS

Descriptive Analysis

Since HLM does not allow for missing values on Level 1 variables, students, who have missing values for any of selected variables, was deleted. All variables in the model were standardized variables, in which they adjusted according to OECD average. "0" means student variable equals OECD average and "1" represents standard deviation of OECD. Final sample size, means and standard deviations of variables were presented in Table 2 for three countries.

Table 2. Descriptive statistics for Turkey, USA and South Korea.

Variables	Turkey			USA			South Korea		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
ESCS	6164	-1.126	1.177	4149	0.104	1.002	6421	0.089	0.768
EMOSUPS	6164	0.048	1.053	4149	0.101	1.003	6421	0.110	0.906
STUBEHA	186	-1.189	0.981	162	0.511	0.812	188	0.001	1.468
ENTUSE_SCH	186	-0.153	0.550	162	-0.041	0.264	188	-0.083	0.224
ICTCLASS_SCH	186	0.220	0.495	162	0.287	0.896	188	0.072	0.398

Notes: ESCS: Economic. Social and Cultural Status; EMOSUPS : Perceived Parents' Emotional Support; STUBEHA: Student Hindering Behavior; ENTUSE_SCH: ICT Use Outside of School for Leisure; ICTCLASS_SCH: Subject Related ICT Usage in Lesson

HLM Analysis

The first step in HLM analysis was calculation of ICCs to identify whether the variances were significant between Level-1(students) and Level 2 (schools). ICCs calculated for each country are given in Table 3.

Table 3. Intraclass Correlation Coefficients for Turkey. USA and South Korea.

ICC	Turkey	USA	South Korea
	0.62208	0.20704	0.23672

The results indicated that ICCs for Turkey. USA and Korea are respectively 62%. 21% and 24%. The smallest ICC was calculated in USA. it means that 21% of total variances could be explained by the differences among schools in USA. For Korea and Turkey ratio of explained variance by school were calculated higher. These high ICCs showed the necessity of using hierarchical model in the analysis.

In the final model (full random coefficient model) 3 variables at Level 1 (gender. ESCS and EMOSUPS) and 3 variables at Level 2 (STUBEHA. ENTUSE_SCH and ICTCLASS_SCH) was inserted to the model to determine the effects of these variables on science achievement. HLM analysis indicated whether these student level and school level variables had significant effects on science achievement and how much the strength of this relation (Table 4)

Table 4. The full random coefficient model for science achievement

	Turkey		USA		South Korea	
	Coefficient	*P*	Coefficient	*P*	Coefficient	*p*
Student Level						
Gender	6.695	**0.005**	2.534	0.601	3.957	0.321
ESCS	4.793	**0.000**	17.117	**0.000**	21.179	**0.000**
EMOSUPS	2.565	**0.001**	3.833	**0.042**	5.769	**0.002**
School Level						
STUBEHA	-22.579	**0.000**	-24.074	**0.000**	-11.839	**0.002**
ENTUSE_SCH	24.675	**0.034**	-39.397	**0.013**	6.871	0.662
ICTCLASS_SCH	8.502	0.598	-1.666	0.727	22.507	**0.010**

At student level, there were three predictors for students' science achievement. Two level HLM results indicated that gender of the students has significant effect on science achievement in Turkey but no significant effect in USA and Korea. In Turkey, female students have approximately 5 points higher score than male in science. Second variable in student level was ESCS. Result showed that family socio-economic status had significant positive effect on students' science achievement in all three counties. When coefficients were evaluated, it was observed that this effect was smaller in Turkey with respect to Korea and USA. The third variable

in student level was perceived emotional support of families. It is found that in all three countries, family support had positive influence on science achievement confirming Hypothesis 1. Strength of this effect was higher in South Korea.

At school level, three variables were added to model. Results indicated that student hindering behavior had negative effect on science achievement for all three countries. Highest coefficient was calculated for USA and smallest coefficient calculated for South Korea. Second variable was ICT usage out of school for leisure. In USA, increase in ICT usage had very strong negative effect on science achievement. On the contrary, ICT usage out of school for leisure had positive effect on science achievement in Turkey. There was no significant effect in South Korea. When mean values of ENTUSE_SCH variable for USA and Turkey was compared, it is observed that USA has mean value (-0.041) very close to OECD average but Turkey has smaller mean value (-0.153) than OECD average and USA. This difference can be attributed to intensity of ICT usage out of school for leisure. The last variable in school level was subject related ICT usage in lessons. HLM results demonstrated that ICTCLASS_SCH had positive effect on science achievement only in South Korea. There was no significant effect calculated for Turkey and USA. In the item (IC150) related with subject related ICT use, it was asked to students that how much time they spend using digital devices during classroom lessons in a typical school week for math, science, foreign language, social sciences, music, sports, visual arts, and performing arts. Means of science achievement scores with respect to student responses are given in Table 5.

Table 5. Means of science achievement scores with respect to spending time for subject related ICT use in classroom

	No time	1 - 30 minutes a week	31 - 60 minutes a week	More than 60 minutes a week
Turkey	462.17	454.12	474.69	518.84
USA	505.50	505.55	503.80	524.78
South Korea	510.44	512.98	515.59	551.35

DISCUSSION, CONCLUSION, LIMITATIONS AND RECOMMEDATIONS

In the discussion part, we evaluated the Turkish, American and Korean students' science skills in PISA 2018. After that, we discussed the interpretation of the main findings then, we gave the limitations of the study and finally. We concluded the paper with recommendations for policy practice and future research.

There were 78 participants in PISA 2018. Average science scores for Turkey, USA and South Korea were 468, 502 and 519; and their ranks were 39, 18 and 7 respectively. Only Turkey obtained science achievement score lower than OECD average (489) among these three countries. When we compared three countries' performance for last 5 cycles of PISA, it is observed that South Korea, USA and Turkey order for science scores was not changing. South Korea was always above the OECD average, USA was very close to OECD average and Turkey was always below the OECD average (Figure 2).

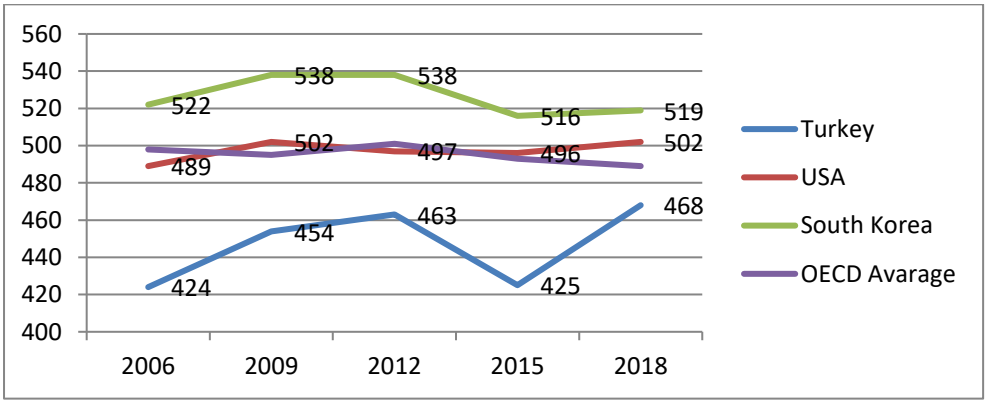

Figure 2. Science performance of Turkey. USA and South Korea in last 5 PISA cycles

We have checked ICC to understand structure of our data to determine whether we should use hierarchical model or not in data analysis. ICC tells us proportion of total variance in science achievement that is accounted for differences between schools. Therefore, ICC can be also evaluated as indicator of achievement gap between schools. Higher ICC value can be evaluated as quality difference among schools (Ertem, 2021). Calculated ICC values are nearly three times higher in Turkey with respect to South Korea and USA (Table 3). This obvious difference in Turkey can be result of competitive examination that applied at the beginning of lycee. Great majority of 15 years students in Turkey is 1st grade of lycee. Students are selected for schools with respect to their academic achievement. This selection causes great achievement gaps among schools.

Our first hypothesis predicted that there is a direct and positive relationship between students' perceived emotional support of families and their science scores in all three countries. The research findings point out that students' perceived emotional support in selected countries had a positive influence on science achievement. This finding parallel to the available literature, which indicates that students' perceived parental support impact their academic scores positively (Chen, 2008; Çobanoğlu and Yurttaş-Kumlu, 2020; Eberbach and Crowley, 2017; Flynn et al., 2018). This means that parental support plays a critical and determinant role in terms of

promoting and strengthening their children's school life and improving academic success. Evidence supports also previous research (Atasoy, 2021; Gonida and Cortina, 2014) that social and emotional support such as parental support has an influence on students' cognitive, emotional, motivational, and behavioral aspects related to school engagement. Students who perceive the presence of parental support can feel more confident and stronger in overcoming the difficulties they encounter in their school life. Hence, they can be more motivated in their lessons.

We have reached also that the strength of parental support effect was more coefficients in South Korea than in Turkey and USA. It can be due to the parents' education level and income and specifically South Koreans educational aspiration based on social and cultural factors about their children identified as Education Fever [GyoYoukYoel]. In South Korean parents, this social and cultural aspect of "GyoYoukYoel" characterizes an intensified social disposition and orientation that reinforce and overemphasize parents' search for higher academic success regardless of the dominant social class and social stratification. This finding is parallel with Kim and Bang (2017) who have emphasized that Korean parents set more expectations academically for their children than those USA. Freeman's (2010) research revealed that parental support of educational aspiration differs between blue working-class parents and white working-class parents in the U.S. In this point, cultural context of Hofstede and "habitus" concept of Bourdieu might be showcase to understand the coefficient differences among selected countries of the study. Hofstede (2001) describes the collectivism–individualism dimension as "the relationship between the individual and the collectivity". In Asian collectivist cultures such as South Korea which people embedded closely in their groups, people tend to attach the norms prevalent, values, beliefs identities and meaningful phenomena in the group and take high importance to their relationship. In this sense, in South Korean parents, the influence collective of the cultural aspect of "GyoYoukYoel" could be prevalent and dominant. Contrary to this, in Western individualist cultures such as USA which people are autonomous individuals, people reflect more independent group behavior and/or tend to acquire a more anonymous form of dependence on impartial institutions and universal norms liberating people from obligations to the extended family. It can be said that emotional parental support has increased in recent years regardless of social stratification because of the parents' positive attribute of education in Turkey which bridges the characteristics of Eastern and Western cultures.

The second hypothesis predicted positive relationship between ESCS and science achievement. ESCS is probably most widely used variables just after student achievement in secondary analysis of PISA (Avvissati, 2020). Similar to previous findings (Yalçın and Tavşancıl, 2014; You, Park, and Delgado, 2021). It is also observed that economic social and cultural status of students had positive impacts on science achievement in all three countries. Strength of impact can be evaluated with calculated coefficients. In USA and South Korea, ESCS is more powerful predictor of science achievement with respect to Turkey. Actually, the strength of relationship between socio-economic profile of students and their performance is an important indicator of fairness of educational system. It indicated that students with low ESCS have limited access to quality education with respect to students with high ESCS (Brighouse et al., 2015). Relative smaller effect of ESCS on achievement in Turkey means that access to quality education is fairer in Turkey with respect to USA and South Korea. This result can be explained with success of the FATIH Project (Movement to Increase Opportunities and Technology). The project has been started in 2010 and covers providing notebook computers for students, LCD panel interactive boards and Internet network infrastructures for classrooms at schools. The main purpose of the Project was providing an equal opportunity in education with help of effective use of ICT (MoNE, 2021).

The third hypothesis claimed there was a significant relationship between students' genders and their science scores. We found out that girls had higher science scores than boys in Turkey, but there were no statistically significant differences between their science scores and gender in USA and South Korea. This result can be implied that girls had higher attention on learning in Turkey. The finding supports the results of previous studies (Freeman, 2004; Ivinson and Murphy, 2003; Machin and Mc Nally, 2005; Şahin and Çoban, 2020). The reason for this could be explained by girls tends to study more responsibly than boys. Especially in developing countries like Turkey, girls should study harder because, in their future lives, it is very hard for them to get a better job without good education. Studies also stated that girls had a higher capability to manage time than boys (Demirtaş and Özer, 2007; Nelson and Nelson, 2003). Their challenge and capability could explain higher academic performance of girls in science in Turkey. On the contrary, there is no significant relationship between students' gender and their science scores in USA and South Korea. The reason for this is proved by the recent studies (Ivinson and Murphy, 2003; Salisbury, Rees, and Gorard, 1999) claiming that the difference is not as significant as previously thought.

Our fourth hypothesis asserts that there is a direct and negative relationship between students' ICT use out of school for leisure and their science scores. The research findings provided contrasting and dissimilar evidence in all selected countries for this hypothesis. The coefficients result of students' ICT use out of school for leisure on science scores in USA supported the hypothesis directly and negatively, but South Korea did not provide it. However, the research findings indicated that students' ICT use out of school for leisure has a positive effect on science scores in Turkey. This finding showing mixed influences on student achievement is parallel to the available literature (OECD, 2018; Skryabin, Zhang, Liu, and Zhang. 2015; Xiao, Liu, and Hu, 2019). which indicates that students' ICT use out of school for leisure impact their academic scores negatively in USA, positively in Turkey, and insignificantly in South Korea. The boosting and/or hindering use of digital resources specifically in out-of-school environments show a tendency to blur the use of frontiers of educational activities. In USA and South Korea, science scores tend to decrease depending on the increasing time spent browsing the internet for fun, playing collaborative and/or one-player games online games, playing online games via social networks. In USA, the negative effect of ICT use outside of school might be taking place in an unsupervised environment and this challenge seems to necessitate monitoring students' activities online, whether they take place in or outside of school. Drawing up to related literature and analyzing compendium data of PISA 2018 detailed, concerning ICT use outside of school in Turkey we can say that the positive effect of this variable depends on multi mixed factors as diverse as time spent browsing

the internet for fun, playing collaborative and/or one-player games online games, playing online games via social networks, students' socio-economic status, parents' attitudes towards ICT use at home, age of first used a digital device, the availability of digital learning resources at home, local internet, and broadband coverage, and the price of ICT resources. In Turkey, the frontiers of ICT use for leisure seem to be useful and adaptive, and supportive clearer than in USA. This means that Turkey's students appear to use more effective and controlled by parents [limited level depending on ESCS and possession of digital resources] informal learning context and play-based learning and have many opportunities to develop certain cognitive processes and including technical skills, such as create some content, solving security settings, share information, connected, digital community interactions, multi-players games, and communicate others. A positive relationship between out-of-school ICT use and science scores in Turkey may depend also on the effective and controlled use of the Education Information Network (EBA) module within the scope of the FATIH project. However, it is thought that there is a need for deeper and longitudinal studies and ICT use for leisure should be carefully analyzed how these activities can contribute to or hinder students' performance and their socialization process.

Our fifth hypothesis proposed that there is positive effect of subject related ICT usage in the classroom while adjusting the influence of relevant background variables like gender, socio-economic status and parental support. The analysis using the HLM indicated that ICT use in class did not have significant effect on science achievement in Turkey and USA but positive effect was observed in South Korea. Difference among three countries can be explained with intensity of using ICT in classroom. Although ICT usage in Turkey and USA were higher than the OECD average, it is nearly same with OECD average in South Korea. This result indicated quality of implementation and integration of ICT into subject much more important than time spend for ICT usage. Similar results demonstrated by Comi et al. (2017). In their study, they obtained evidence for positive affect of ICT-related teaching practice on student achievement. They found that computer-based teaching method increased student success when students' awareness and communication enhanced in ICT use. Therefore, they concluded that effectiveness of ICT usage at classroom was highly depending on teachers' ability to integrate ICT into their teaching practices. There are also many studies underlined the effect of students' background characteristics on efficiency of ICT usage for lecturing (Chinn and Fairlie, 2010). Aypay (2010) evaluated PISA 2006 result of Turkey and found no significant relation between students' ICT skills and academic achievement. On the contrary, Delen and Bulut (2011) examine 2009 PISA results of Turkey and concluded that exposure to ICT at home and school was a strong predictor of science performance. Odell, Cutimusu and Gierl (2020) reviewed 25 publications to find out relationship between ICT and performance score in math and science and they indicated that this relation is not consistent. Direction of relationship is changing with respect to subject and countries. Although there was no consensus, they supposed that moderate use of ICT, rather than higher or no use, can be predictor of achievement in positive way. In addition to intensity of ICT usage. autonomy and interest of student towards ICT also affected students' achievement positively.

Our sixth hypothesis claims that there is a direct and negative relationship between students' hindering behaviors and their science scores and the findings provide evidence for this hypothesis in Turkey, USA, and South Korea. This finding compatible with the current literature that indicates that students' hindering behaviors impact their academic scores negatively (Barutçu Yıldırım, and Demir, 2019; Şahin and Çoban, 2020; Török, Szabó, and Tóth, 2018). These studies underlined that students' hindering behaviors have negative effects not only on their academic performance but also on their well-being. As a result of these negative effects, students might drop out their schools. Avoid from this disappointing situation, parents, teachers and principals should collaborate to create supportive, peaceful and motivating learning climates for children at schools and homes.

As a result, present study revealed that although family support and ESCS had a positive influence on science achievement in all three countries, student hindering behavior had a negative impact on it. In addition to these factors, effect of gender and ICT usage on achievement differed with respect to countries parallel to previous findings. This variation can be attributed to social, cultural, economic differences among these countries. In conclusion, policy makers should pay attention to these critical issues planning, development and implementation processes of educational policy to enhance student achievement.

Study limitations

After discussing the findings of the study, it is vital to give the limitations of the research. We selected three countries form the PISA data set to test our model. Further studies may choose different countries to test the model. Present study tried to investigate relationship between ICT use for academic purposes and non-academic purposes on students' science achievement in these three countries. Information gathered by PISA student questionnaire indicates only quantitative dimension of ICT usage. It is also necessary to take quality of implementation into consideration to make more comprehensive evaluation. Plenty of factors like conditions of schools; quality, experience and attitude of teachers; approach of parents etc. can affect implementation quality. Sampling method of PISA can be also obstacle to identify classroom environment since students selected from one school is coming from different classrooms. Another limitation for this study is cross-sectional nature of available data set. Our analysis could only describe relationship between selected independent variables and dependent variables, no causality conclusion can be drawn. It is necessary to conduct longitudinal research to determine real progress among students in the selected model. The third limitation of this study is related to variations in the countries. All three countries evaluated the study are very crowded countries. There should be great differences among regions in the same countries. Therefore, it is necessary to focus on various parameters of different regions in the countries to make more accurate conclusion.

Conclusion

In conclusion, we recommended a wider model, including more student related factors to see the big picture for students' achievement. Many factors affecting student achievement are related with quality of instruction rather than quantity so it is vital to add qualitative data to make more detailed and pointed assessment for further researches. To evaluate student progress, it is necessary to know students' prior knowledge. Therefore, researchers may focus on longitudinal studies containing background of students. We also supposed to design new researches focusing on regional educational policy, cultural and financial issues to understand factor effecting science achievement.

Ethics and Consent: Ethical approval was not sought for the present study because data set has been taken from PISA 2018 survey. Ethics committee permission is not applicable because this article does not contain any studies with human or animal subjects.

REFERENCES

Ainley J., Enger L., & Searle D. (2008). Students in a digital age: Implications of ICT for teaching and learning. In *International handbook of information technology in primary and secondary education* (pp. 63-80). Springer. Boston. MA.

Aslanargun E. (2007). Okul-aile işbirliği ve öğrenci başarısı üzerine bir tarama çalışma. *Manas Üniversitesi Sosyal Bilimler Dergisi, 9*(18), 119-135.

Atasoy R. (2021). Öğrencilerin okula bağlılığı. N. Özdemir. S. Turan ve Ö. Çoban (Ed.). *21. yüzyıl okullarını yeniden düşünmek* (ss. 335-366). Ankara: Pegem Akademi.

Avvissati F. (2020). The measure of socio-economic status in PISA: a review and some suggested improvements. *Large-Scale Assessments in Education, 8*(8), 1-37. https://doi.org/10.1186/s40536-020-00086-x

Aypay A. (2010). Information and communication technology (ICT) usage and achievement of Turkish students in PISA 2006. *Turkish Online Journal of Educational Technology-TOJET, 9*(2), 116-124.

Barrow L., Markman L., & Rouse C. E. (2009). Technology's edge: The educational benefits of computer-aided instruction. *American Economic Journal: Economic Policy, 1,* 52–74.

Barutçu Yıldırım F., & Demir A. (2019). Self-handicapping among university students: The role of procrastination. test anxiety. self-esteem. and self-compassion. *Psychological Reports*. https://doi.org/10.1177/0033294118825099.

Brighouse H., Ladd H., Loeb S., & Swift A. (2015). Educational goods and values: A framework for decision makers. *Theory and Research in Education, 14*(1), 3–25.

Bruniges M. (2003). Developing performance indicators for ICT use in education: Australia's experience. http://www2.unescobkk.org/education/ict/v2/info.asp?id=13249

Bryk A. S., Sebring P. B., & Allensworth E. (2010). *Organizing schools for improvement: Lessons from Chicago*. Chicago: University of Chicago Press. https://doi.org/10.7208/chicago/9780226078014.001.0001.

Boonk L., Gijselaers H. J., Ritzen H., & Brand-Gruwel S. (2018). A review of the relationship between parental involvement indicators and academic achievement. *Educational Research Review, 24,* 10-30. https://doi.org/10.1016/j.edurev.2018.02.001

Carretero S., R. Vuorikari, & Y. Punie (2017). *Dig Comp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use.* European Commission. http://dx.doi.org/10.2760/38842

Castro M., Exposito-Casas E., Lopez-Martin E., Lizasoain L., Navarro-Asencio E., & Gaviria. J. L. (2015). Parental involvement on student academic achievement: A meta-analysis. *Educational Research Review, 14,* 33–46. https://doi.org/10.1016/j.edurev.2015.01.002

Chen J. J. L. (2008). Grade-level differences: Relations of parental teacher and peer support to academic engagement and achievement among Hong Kong students. *School Psychology International, 29*(2), 183-198. https://doi.org/10.1177/0143034308090059

Cheung. A. C. K., & Slavin R. E. (2013). The effectiveness of educational technology applications for enhancing mathematics achievement in K-12 classrooms: A meta analysis. *Educational Research Review, 9,* 88–113. https://doi.org/10.1016/j.edurev.2013.01.001

Chinn M. D., & Fairlie R. W. (2010). ICT use in the developing world: an analysis of differences in computer and internet penetration. *Review of International Economics, 18*(1), 153-167. https://doi.org/10.1111/j.1467-9396.2009.00861.x

Coban O., & Atasoy R. (2019). An examination of relationship between teachers' self-efficacy perception on ICT and their attitude towards ICT usage in the classroom. *Cypriot Journal of Educational Sciences, 14*(1), 136-145.

Coleman J. S., Campbell E. Q., Hobson C. J., McPartland J., Mood. A. M., Weinfeld. F. D., & York R. L. (1966). *Equality of educational opportunity*. Washington. DC: U.S. Government Printing Office.

Comi S. L., Argentin G., Gui M., Origo F., & Pagani L. (2017). Is it the way they use it? Teachers. ICT and student achievement. *Economics of Education Review. 56*. 24-39. https://doi.org/10.1016/j.econedurev.2016.11.007

Çoban Ö., Özdemir N., & Bellibaş M. Ş. (2020). Trust in principals. leaders' focus on instruction. teacher collaboration. and teacher self-efficacy: testing a multilevel mediation model. *Educational Management Administration & Leadership*. 1741143220968170.

Çobanoğlu R., & Yurttaş-Kumlu G. D. (2020). Children's science learning outside school: Parental support. *Turkish Journal of Education, 9*(1), 46-63. https://doi.org/10.19128/turje.613091

Dabney K. P., Chakraverty D., & Tai. R. H. (2013). The association of family influence and initial interest in science. *Science Education, 97*(3), 395-409. https://doi.org/10.1002/sce.21060

Daniel J. (2012). Choosing the type of probability sampling. In: Daniel J (Ed.). *Sampling essentials: Practical guidelines for making sampling choices.* Thousand Oaks. California: SAGE Publications. Inc. https://doi.org/10.4135/9781452272047

Delen E., & Bulut O. (2011). The relationship between students' exposure to technology and their achievement in science and math. *Turkish Online Journal of Educational Technology-TOJET, 10*(3). 311-317.

Dumais S. A. (2002). Cultural capital, gender and school success: The role of habitus. *Sociology of Education, 75*(1), 44–68. https://doi.org/10.2307/3090253.

Demirtaş H., & Özer N. (2007). Öğretmen adaylarının zaman yönetimi becerileri ile akademik başarısı arasındaki ilişkisi. *Eğitimde Politika Analizleri ve Stratejik Araştırmalar Dergisi, 2*(1), 34-47.

Eberbach C., & Crowley K. (2017). From seeing to observing: How parents and children learn to see science in a botanical garden. *Journal of the Learning Sciences, 26*(4), 608-642. https://doi.org/10.1080/10508406.2017.1308867

Ehrlich K. B., Dykas. M. J., & Cassidy. J. (2012). Tipping points in adolescent adjustment: Predicting social functioning from adolescents' conflict with parents and friends. *Journal of Family Psychology, 26,* 776-783. https://doi.org/10.1037/a0029868

Ertem. H. Y. (2021). Examination of system of transition to upper-secondary schools from lower-secondary schools in terms of student. class. and school level variables. *Problems of Education in the 21st Century, 79*(2), 194-206.

ETS [Educational Testing Service]. (2002). *Digital transformation*. Princeton: A framework for ICT literacy.

European Commission. (2013). *Survey of schools; ICT in education.* Luxembourg: The European Union.

Ferrari. A. (2012). *Digital competence in practice: An analysis of frameworks*. *(Report EUR 25351 EN).* Luxembourg: Publications Office of the European Union.

Flynn H. K., Felmlee D. H., Shu X., & Conger, R. D. (2018). Mothers and fathers matter: The influence of parental support. hostility. and problem solving on adolescent friendships. *Journal of Family Issues, 39*(8), 2389-2412. https://doi.org/10.1177/0192513X18755423

Fraillon J., Schulz W., & Ainley J. (2013). *International computer and information literacy study: Assessment framework.* Amsterdam: IEA.

Fraillon J., Schulz W., Gebhardt E., & J. Ainley (2015). *National assessment program: ICT literacy years 6 & 10 Report 2014.* Australian Curriculum. Assessment and Reporting Authority (ACARA). Sydney. https://research.acer.edu.au/ict_literacy/11.

Freeman C. E. (2004). Trends in educational equity of girls & women: 2004. NCES 2005-016. *National Center for Education Statistics.*

Freeman M. (2010). Knowledge is acting: Working-class parents' intentional acts of positioning within the discursive practice of involvement. *International Journal of Qualitative Studies in Education, 23*(2), 181–198. https://doi.org/10.1080/09518390903081629

Fuchs T., & Woessmann L. (2004). *Computers and student learning: bivariate and multivariate evidence on the availability and use of computers at home and at school* (Munich. CESifo GmbH).

Garson G. D. (2014). Fundamentals of hierarchical linear and multilevel modeling. In *Hierarchical linear modeling: guide and applications*. SAGE Publications. Inc. DOI: https://dx.doi.org/10.4135/9781483384450.

Goddard R., Goddard Y., & Sook Kim E. (2015). A theoretical and empirical analysis of the roles of instructional leadership. teacher collaboration and collective efficacy beliefs in support of student learning. *American Journal of Education, 121*(4), 501–530. https://doi.org/10.1086/681925

Goddard Y. L., Goddard R. D., Bailes L. P., & Nichols R. (2019). From school leadership to differentiated instruction: a pathway to student learning in schools. *The Elementary School Journal, 120*(2), 197–219. https://doi.org/10.1086/705827

Gonida E. N., & Cortina K. S. (2014). Parental involvement in homework: Relations with parent and student achievement-related motivational beliefs and achievement. *British Journal of Educational Psychology, 84*(3), 376-396.

Gore J. M., Miller A., Fray L., Harris J., & Prieto. E. (2021). Improving student achievement through professional development: Results from a randomised controlled trial of Quality Teaching Rounds. *Teaching and Teacher Education, 101,*1-12.

Gumus S., & Atalmis E. H. (2011). Exploring the relationship between purpose of computer usage and reading skills of Turkish students: Evidence from PISA 2006 .*The Turkish Online Journal of Educational Technology, 10,* 129-140.

Hallinger P., & Heck R. H. (1996). Reassessing the principal's role in school effectiveness: a review of empirical research. 1980-1995. *Educational Administration Quarterly, 32*(1), 5–44. https://doi.org/10.1177/0013161X96032001002

Hallinger P., & Murphy J. F. (1986). The social context of effective schools. *American Journal of Education, 94*(3), 328–355. https://doi.org/10.1086/443853.

Hill N. E., & Taylor L. C. (2004). Parental school involvement and children's academic achievement: Pragmatics and issues. *Current Directions in Psychology Science, 13,* 161–164. https://doi.org/10.1111/j.0963-7214.2004.00298.x

Hofstede G. (2001). *Culture's consequences: Comparing values, behaviors, institutions, and organizations across nations.* Thousand Oaks. CA: SAGE.

Hornby G., & Lafaele. R. (2011). Barriers to parental involvement in education: An explanatory model. *Educational Review, 63*(1), 37–52. https://doi.org/10.1080/00131911.2010.488049

House J. (2007). Relationships between computer use and reading achievement of elementary-school students: Results from the PIRLS 2001 assessment. *International Journal of Instructional Media, 34,* 449–456.

Ilter B. G. (2009). Effect of technology on motivation in EFL classrooms. *Turkish Online Journal of Distance Education, 10*(4), 136-158.

Ivinson G., & Murphy P. (2003). Boys don't write romance: The construction of knowledge and social gender identities in English classrooms. *Pedagogy Culture and Society, 11*(1), 89–111. https://doi.org/10.1080/14681360300200162

Jeynes W. H. (2011). *Parental involvement and academic success.* New York. NY: Routledge.

Jones E. E., & Berglas S. (1978). Control of attributions about the self through self-handicapping strategies: The appeal of alcohol and the role of underachievement. *Personality and Social Psychology Bulletin, 4*(2), 200-206. https://doi.org/10.1177/014616727800400205

Johnson B., & Stevens J. J. (2006). Student achievement and elementary teachers' perceptions of school climate. *Learning Environments Research, 9*(2), 111–122. https://doi.org/10.1007/s10984-006-9007-7.

Kreft I., & de Leeuw J. (1998). *Introducing multilevel modeling.* Newbury Park. CA: Sage.

Kim J. S., & Bang H. (2017). Education fever: Korean parents' aspirations for their children's schooling and future career. *Pedagogy. Culture & Society, 25*(2), 207-224. https://doi.org/10.1080/14681366.2016.1252419

Lee S., & Shouse R. (2008). Is education fever treatable? Case studies of first-year Korean students in an American University. *KEDI Journal of Educational Policy, 5*(2), 113-132.

Lee V. E. (2000). Using hierarchical linear modeling to study social contexts: the case of school effects. *Educational Psychologist. 35*(2), 125-141. https://doi.org/10.1207/S15326985EP3502_6

Lennon, M., Kirsch I., von Davier M., Wagner M., & Yamamoto K. (2003). *Feasibility study for the PISA ICT literacy assessment. report to network A.*. In. Retrieved from http://eric.ed.gov/PDFS/ED504 154.pdf.

Lorenz R., Eickelmann B., & Gerick J. (2015. March). What affects students' computer and information literacy around the world?–An analysis of school and teacher factors in high performing countries. In *Society for Information Technology & Teacher Education International Conference (pp. 1212-1219).* Association for the Advancement of Computing in Education (AACE).

Machin S., & McNally S. (2005). Gender and student achievement in English schools. *Oxford Review of Economic Policy, 21*(3), 357-372. https://doi.org/10.1093/oxrep/gri021

MacNeil A. J., Prater D. L., & Busch S. (2009). The effects of school culture and climate on student achievement. *International Journal of Leadership in Education, 12*(1), 73–84. https://doi.org/10.1080/13603120701576241.

Mahdum M., Hadriana H., & Safriyanti M. (2019). Exploring teacher perceptions and motivations to ICT use in learning activities in Indonesia. *Journal of Information Technology Education, 18*, 24-37. https://doi.org/10.28945/4366

Mayer R. E. (2009). *Multimedia learning* (2nd ed.). New York: Cambridge University Press.

MoNE (2021). FATIH Project Our Mission and Vision. http://fatihprojesi.meb.gov.tr/en/about.html.

Murray D. (2005). *Information technology and innovation in language education*. In Davison C. (E.d.) Hong Kong: Hong Kong University press.

Nelson D. B., & Nelson K. W. (2003, March). *Emotional intelligence skills: Significant factors in freshmen achievement and retention.* Paper presented at the American Counselling Association Conference. Anaheim. CA.

Odell B., Cutumisu M., & Gierl M. (2020). A scoping review of the relationship between students' ICT and performance in mathematics and science in the PISA data. *Social Psychology of Education,* 1-33. https://doi.org/10.1007/s11218-020-09591-x

OECD (2005). *Teachers matter: Attracting, developing and retaining effective teachers*. Paris: OECD Publishing.

OECD (2015). *Students, computers and learning: Making the connection. PISA:* Author. doi: 10.1787/9789264239555

OECD (2018). *Preparing Our Youth for an Inclusive and Sustainable World: The OECD PISA global competence framework.* http://www.oecd.org/pisa/Handbook-PISA-2018-Global-Competence.pdf.

OECD (2019). *PISA 2018 results.* Paris: OECD Publication.

Özdemir N. (2019). Principal leadership and students' achievement: Mediated pathways of professional community and teachers' instructional practices. *KEDI Journal of Educational Policy, 16*(1), 81-104.

Özdemir N., & Yalcın M.T. (2019). Examination of the relationships between academic achievement and the variables at the levels of school and students in secondary schools: two-level path analysis. *Education and Science, 44*(200), 93–116. https://dx.doi.org/10.15390/EB.2019.8056

Pennington M. C. (1996). *The Power of CALL.* Houston: Athelstan.

Putwain D. W. (2019). An examination of the self-referent executive processing model of test anxiety: control. emotional regulation. self-handicapping. and examination performance. *European Journal of Psychology of Education, 34*(2), 341-358. https://doi.org/10.1007/s10212-018-0383-z

Rank T., Warren C., & Millum T. (2011). *Teaching English using ICT: A Practical Guide for Secondary School Teachers.* New York.NY: Continuum International Publishing Group.

Raudenbush S. W., & Bryk A. S. (2002). *Hierarchical Linear Models: Applications and data analysis methods*. Second edition. Chicago.

Sarıer Y. (2016). Türkiye'de öğrencilerin akademik başarısını etkileyen faktörler: bir meta-analiz çalışması. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 31*(3), 609-627. https://doi.org/10.16986/HUJE.2016015868

Sebastian J., Huang H., & Allensworth E. (2017). Examining integrated leadership systems in high schools: connecting principal and teacher leadership to organizational processes and student outcomes. *School Effectiveness and School Improvement, 28*(3). 463–488. https://doi.org/10.1080/09243453.2017.1319392

Salisbury J., Rees G., & Gorard S. (1999). Accounting for the differential attainment of boys and girls at school. *School Leadership and Management, 19*(4), 403–426. https://doi.org/10.1080/13632439968943

Skryabin M., Zhang J. J., Liu L., & Zhang D. (2015). How the ICT development level and usage influence student achievement in reading, mathematics, and science. *Computers & Education, 85,* 49–58. https://doi.org/10.1016/j.compedu.2015.02.004

Şahin F., & Çoban Ö. (2020). Effect of school climate, students 'self-handicapping behaviors and demographic characteristics on students' achievement. *I.E.: Inquiry in Education, 12*(2), 1-20. https://digitalcommons.nl.edu/ie/vol12/iss2/6

Tamim R. M., Bernard R. M., Borokhovski E., Abrami P. C., & Schmid. R. F. (2011). What forty years of research says about the impact of technology on learning: A second-order meta-analysis and validation study. *Review of Educational Research, 81,* 4-28. https://doi.org/10.3102/0034654310393361

Tan C. Y., Lyu M., & Peng B. (2020). Academic benefits from parental involvement are stratified by parental socioeconomic status: A meta-analysis. *Parenting, 20*(4), 241-287. https://doi.org/10.1080/15295192.2019.1694836

Thomas C. R., & Gadbois S. A. (2007). Academic self-handicapping: The role of self-concept clarity and students' learning strategies. *British Journal of Educational Psychology, 77*(1), 101-119. https://doi.org/10.1348/000709905X79644

Török L., Szabó Z. P., & Tóth L. (2018). A critical review of the literature on academic self-handicapping: theory. manifestations. prevention and measurement. *Social Psychology of Education, 21*(5), 1175-1202. https://doi.org/10.1007/s11218-018-9460-z

Uluyol Ç., & Şahin S. (2016). Elementary school teachers' ICT use in the classroom and their motivators for using ICT. *British Journal of Educational Technology, 47*(1), 65-75. https://doi.org/10.1111/bjet.12220

Xiao Y., Liu Y., & Hu J. (2019). Regression analysis of ICT impact factors on early adolescents' reading proficiency in five high-performing countries. *Frontiers in Psychology, 10, 1646.* https://doi.org/10.3389/fpsyg.2019.01646

Voyer D., & Voyer, S. D. (2014). Gender differences in scholastic achievement: A meta- analysis. *Psychological Bulletin, 140*(4), 1174–1204. https://doi.org/10.1037/a0036620

Wang Y., Deng C., & Yang X. (2016). Family economic status and parental involvement: Influences of parental expectation and perceived barriers. *School Psychology International, 37*(5), 536–553. https://doi.org/10.1177/0143034316667646

Wentzel K. R., & Miele D. B. (Eds.). (2016). *Handbook of motivation at school* (2nd ed). New York: Routledge.

Willms J. D., & Smith T. M. (2005). *A manual for conducting analyses with data from TIMSS and PISA*. A report prepared for the UNESCO institute for statistics. Retrieved October 13. 2010.

Willms J., & Tramonte L. (2015). Towards the development of contextual questionnaires for the PISA for development study. *In OECD education working papers* (Vol. 2015). Paris: OECD Publishing. https://dx.doi.org/10.1787/5js1kv8crsjf-en.

Woessmann L., & Fuchs. T. (2005). Computers and student learning: bivariate and multivariate evidence on the availability and use of computers at home and at school. *CESifo Working Pap*., *47*, 339–347.

Yalçın S., & Tavşancıl E. (2014). The comparison of Turkish students' PISA achievement levels by year via data envelopment analysis. *Educational Sciences: Theory & Practice, 14*(3), 961-968. https://doi.org/10.12738/estp.2014.3.1748

You, H. S., Park. S., & Delgado C. (2021). A closer look at US schools: What characteristics are associated with scientific literacy? A multivariate multilevel analysis using PISA 2015. *Science Education, 105*, 406–437. https://doi.org/10.1002/sce.21609

Yu C. C. W., Chan. S., Cheng F., Sung R. Y. T., & Hau K. T. (2006). Are physical activity and academic performance compatible? Academic achievement. conduct. physical activity and self-esteem of Hong Kong Chinese primary school children. *Educational Studies, 32*(4), 331–341. https://doi.org/10.1080/03055690600850016

Yu J., & McLellan R. (2019). Beyond academic achievement goals: The importance of social achievement goals in explaining gender differences in self-handicapping. *Learning and Individual Differences*, *69*, 33-44. https://doi.org/10.1016/j.lindif.2018.11.010

Zhong Z. J. (2011). From access to usage: The divide of self-reported digital skills among adolescents. *Computers & Education. 56*(3), 736–746. https://doi.org/10.1016/j.compedu.2010.10.016