An investigation of factors related to collaborative problem-solving skills with mediation models

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Abstract: This study investigated the factors that are directly and indirectly related to collaborative problem-solving skills of students in Türkiye with multiple and multilevel mediation models, according to PISA 2015 results. The PISA 2015 Türkiye sample consisted of 5895 students. After missing data assignment and outlier analysis, the analyses were performed over the data set of 5882 students. In this study, whether the variables of valuing teamwork and valuing relationships show a mediation effect was tested with the Bootstrap method through multiple mediation models constructed with the dependent variable of collaborative problem-solving and the independent variables of school belonging and disciplinary climate. Our analyses revealed that the mediator variables had significant effects between school belonging and collaborative problem-solving. Similarly, the mediation effect between the disciplinary climate and the collaborative problem-solving was also significant. Multilevel mediation models constructed with the independent variables of students' behavior hindering learning and extracurricular creative activities were analyzed with the multilevel structural equation modeling. The findings indicated that the variables of valuing relationships and valuing teamwork did not have a significant mediation effect between extracurricular creative activities and collaborative problem-solving scores. Similarly, it was found that the mediation effect between the students' behavior hindering learning and collaborative problem-solving scores was not significant. In light of all these findings, it is recommended that school practices be strengthened to improve students' sense of belonging to school and a positive disciplinary climate, to develop students' collaborative problem-solving skills, and to improve attitudes towards collaboration.

1. INTRODUCTION

According to the Organization for Economic Co-operation and Development (OECD), cognitive skills, as well as non-cognitive skills associated with them, draw attention to education. Interpersonal and social skills which are non-cognitive skills play the role of mediators for the appearance or development of cognitive skills (Marzano & Heflebower, 2012; Kutlu & Kula-Kartal, 2018). On the other hand, school- and classroom-level features generally have a weaker effect on students' academic performance, compared to students' characteristics.

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This indicates that students' characteristics may have a direct effect on students' academic performance, while their school and classroom-level skills may have an indirect effect. However, school- and classroom-level features can have a direct effect on non-cognitive skills (like self-efficacy, motivation, etc.) and students' behavior (like skipping school, bullying, etc.) (OECD, 2017a; OECD, 2017b). In this context, the Programme for International Student Assessment (PISA) provides an important opportunity to determine the relationships between non-cognitive skills and students' academic performance.

The data obtained through PISA are used for determining the factors associated with student achievement and developing standards to increase the quality of education systems (OECD, 2017a). In PISA, each semester focuses on only one of the domains covering reading literacy, science literacy, and maths literacy. Through PISA, the OECD has made assessments in these basic areas, as well as in problem-solving and individual (creative) problem-solving in the 2003 and 2012 frameworks, and in collaborative problem-solving (CPS) in the 2015 framework. The 21st century requires acquiring high-level thinking skills, such as problem-solving, as well as an understanding of key academic content. Openness to problem-solving also affects students' academic achievement in other learning domains. Therefore, different dimensions of problem-solving skills need to be evaluated and learning environments and measurement and evaluation methods should be regulated in this direction (Kutlu et al., 2017; OECD, 2017a).

In today's world, skills such as creativity, solving complex problems, written and verbal communication, and working in collaboration have emerged as skills required for the workforce. The development of these skills requires that learning environments are organized in such a way that students are forced to communicate effectively, manage conflict, form teams, and reach a consensus on the issues necessary for living together. Schools must use the activities required by the CPS and carry out assessments and evaluations accordingly. (Kutlu & Kula-Kartal, 2018; McKenna, 2017). Making assessments for CPS skills in PISA is important in this sense.

CPS competency in PISA 2015 was defined as: "the capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution and pooling their knowledge, skills, and efforts to reach that solution" (OECD, 2017a; OECD, 2017c). Individual problem-solving skills (understanding the problem content, applying problem-solving strategies, etc.) and collaboration components (cognitive and social skills to allow shared understanding, knowledge, and information flow, to create and understand an appropriate team organization, and to perform coordinated actions) have clustered within the scope of CPS (OECD, 2017a; OECD, 2017c).

Students' characteristic features such as interpersonal skills, personality traits, motives, self-efficacy perceptions, and perspectives on various issues affect their individual problem-solving and collaboration skills (Charles & Lester, 1982; Morgeson et al., 2005; Yayan, 2010). Assessments on problem-solving and individual (creative) problem-solving domains in PISA 2003 and PISA 2012 assessments provide an important source of data for determining the factors related to the problem-solving skills of students in Turkey (Aşkar & Olkun, 2005; Akyüz & Pala, 2010; Birbiri, 2014; İleritürk et al., 2017; Pala, 2008; Sertkaya, 2016). The majority of these studies that aim to determine the factors related to students' academic performance in the PISA problem-solving domain discussed the direct effects between variables. Using methods for determining the mediation effect is thought to be more effective in revealing the factors related to student achievement because of the complex relationships between variables.

Given the importance of determining CPS skills and the factors affecting these skills, it is crucial to investigate the factors related to the CPS skills of students in Turkey either directly or indirectly. The purpose of this study is to examine the factors that are directly and indirectly

related to CPS skills of students in Turkey with multiple and multilevel mediation models using PISA 2015. Within this general purpose, the following research questions are sought (the variables in the research questions are explained under the title of "Models set within the scope of the research" in the method section).

1. In the multiple mediation model, do the attitudes towards collaboration (index of valuing teamwork and index of valuing relationships) have a mediation effect on the relationship between a sense of belonging at school and CPS skills?
2. In the multiple mediation model, do the attitudes towards collaboration (index of valuing teamwork and index of valuing relationships) have a mediation effect on the relationship between disciplinary climate and CPS skills?
3. In the multilevel mediation model, do the attitudes towards collaboration (index of valuing teamwork and index of valuing relationships) have a mediation effect on the relationship between extracurricular creative activities and CPS skills?
4. In the multilevel mediation model, do the attitudes towards collaboration (index of valuing teamwork and index of valuing relationships) have a mediation effect on the relationship between students' behavior hindering learning and CPS skills?

2. METHOD

As this research aims to determine the factors related to CPS skills, the relational survey model, one of the general survey models, was used in the study (Tabachnick & Fidell, 2013).

2.1. Sample

The PISA 2015 assessment was conducted with the participation of approximately 540,000 students from 72 participating countries and economies, representing approximately 29 million students. Assessment on the CPS domain, on the other hand, was performed with the participation of approximately 125,000 students from 52 countries (OECD, 2017c). The sample of Turkey in the PISA 2015 assessment included 5895 students and 187 schools selected by cluster sampling method. In the PISA assessment, the school sample was determined by stratified random sampling method stratification according to school type and location of schools. In the second stage, on the other hand, the students to participate in the assessment in these schools were determined by random method.

2.2. Data Collection Tools

In this study, data on variables within the scope of attitudes towards collaboration such as valuing relationships and valuing teamwork variables, sense of belonging at school, and disciplinary climate were obtained from the student questionnaire under the PISA 2015 Turkey assessment, while the data on variables of students' behavior hindering learning and extracurricular creative activities were obtained from the school questionnaire. Scores related to the CPS skills were obtained from the PISA 2015 achievement test.

2.3. Models Set Within the Scope of the Research

The research aimed to determine the factors that have a direct and indirect relationship with the CPS skills of students in Turkey through multiple and multilevel mediation models. Within the scope of the study, the possible factors affecting the CPS skills of the students were determined by the literature review, taking into account the components of CPS skills, problem-solving, and collaboration components. For this purpose, multiple and multilevel mediation models were set.

PISA encompasses students' attitudes towards collaboration, which is among the non-cognitive skills thought to be related to students' achievement in the CPS domain. In PISA 2015, students' attitudes towards collaboration were examined through the index of "valuing teamwork

(COOPERATE)" and the index of "valuing relationships (CPSVALUE)". Valuing relationships is defined as altruistic interactions when the student engages in collaborative activities while valuing teamwork is about what teamwork can produce contrary to working alone (OECD, 2017c). The data on the attitude towards collaboration variable consists of the indexes of valuing teamwork and valuing relationships.

Students' interactions with other elements in the school are significantly related to their interpersonal skills, which are addressed within the framework of CPS skills. One of the concepts considered in this context is students' sense of belonging at school (OECD, 2017c). The sense of belonging at school gives students a sense of security, identity, and community, and all these gains could support academic, psychological, and social development (Adelabu, 2007; Anderman, 2002; Booker, 2004; Goodenow & Grady, 1993; Kutlu & Kula-Kartal, 2018; OECD, 2017d; Sarı, 2013; Sarı & Özgök, 2014).

The characteristics related to the learning environments such as teaching practices, teacher attitudes, classroom climate, competitive learning environment, classroom size, etc. were found to be associated with students' problem-solving skills (Begde, 2015; Çilingir, 2015; Ebret, 2015; Koçoğlu, 2017; Konu, 2017; Kurbal, 2015; Yayan, 2010). The PISA 2015 examined the effect of the school climate on student achievement under the heading learning environments. Schools with a good climate minimize violence, bullying, threats, and oppression, moreover, it ensures educating students who respect one another, have learned the culture of living together, and learned to be a team instead of a power struggle (Doğan, 2017). One of the variables covered by the school climate is the disciplinary climate (OECD, 2017c). A disciplined and fair learning environment helps students acquire social skills that will enable them to construct rewarding relationships at school, which they need to build with both their peers and teachers. Besides, there is a strong relationship between disciplinary climate and the sense of belonging at school (OECD, 2017e). In this regard, in the PISA 2015, students were asked about the frequency of behaviors in the classroom that hinder learning, and thus, the index of disciplinary climate was constructed.

Considering the effects of students' sense of belonging at school and their perceptions of disciplinary climate on their collaboration approaches, which are the social dimensions of CPS, mediation models were constructed. Thanks to the mediation models constructed, the effect of students' sense of belonging at school and the disciplinary climate they perceive on their CPS skills were examined through students' attitudes towards collaboration. The variable of attitude towards collaboration was addressed with the index of valuing teamwork and valuing relationships. Because there are multiple mediators, the mediation models constructed were multiple mediation models. The multiple mediation models constructed with the independent variables of sense of school belonging at school and disciplinary climate are shown in Figure 1.

Figure 1. *Multiple mediation models constructed within the scope of research.*
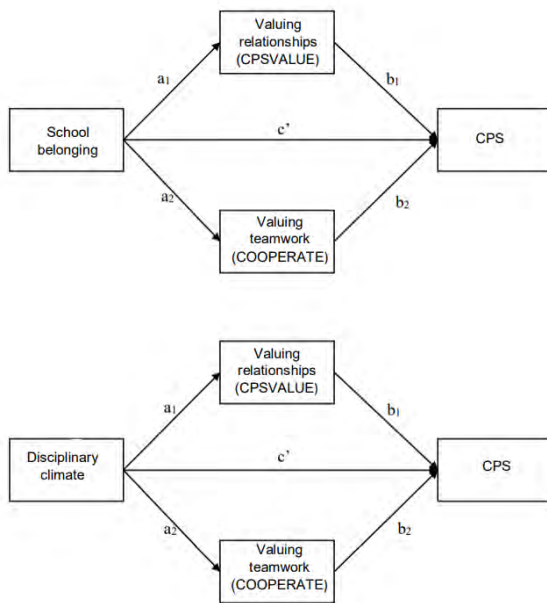
The PISA 2015 assessed the effects of the school climate on both students' behavior and their academic achievements. In this context, relations between students and student activities were discussed. To determine how student behavior affects the learning environment, school principals were asked, using the school questionnaire, to what extent student truancy, skipping school, lacking respect for teachers, using alcohol or illegal drugs, and bullying other students hinder student learning. Using the data obtained in this way, the index of students' behavior hindering learning (STUBEHA) was constructed (OECD, 2017e). Activities such as sports, music and discussion groups, etc. contribute to the development of students' cognitive and non-cognitive skills. Among them, skills such as independence, compliance with guidelines, and getting on well with authority figures and peers are very important in the development of students' CPS skills in school life (and beyond) (Carneiro & Heckman, 2005; Covay & Carbonaro, 2010; Farb & Matjasko, 2012; Farkas, 2003; Howie et al., 2010, as cited in OECD, 2017c). In this sense, in the PISA 2015 school questionnaire, school principals were asked to report what extracurricular activities their schools offered to 15-year-old students, and the index of creative extracurricular activities at school (CREACTIV) was computed (OECD, 2017e).

Considering the effect of school climate on both students' behavior and academic achievement, mediation models were constructed to determine the relationship between students' CPS skills and student activities and inter-student relations. Mediators in both mediation models constructed are the variables of valuing teamwork (COOPERATE) and valuing relationship (CPSVALUE), which are the subgroups of attitude towards collaboration. Since the independent variables of extracurricular creative activities (CREACTIV) and students' behavior hindering learning (STUBEHA) collected from school principals through the school questionnaire are group-level (level-2) variables, the mediation models are multilevel mediation models. The multilevel mediation models constructed with the independent variables of extracurricular creative activities (CREACTIV) and students' behavior hindering learning (STUBEHA) are shown in Figure 2.

Figure 2. *Multilevel mediation models set within the scope of research.*
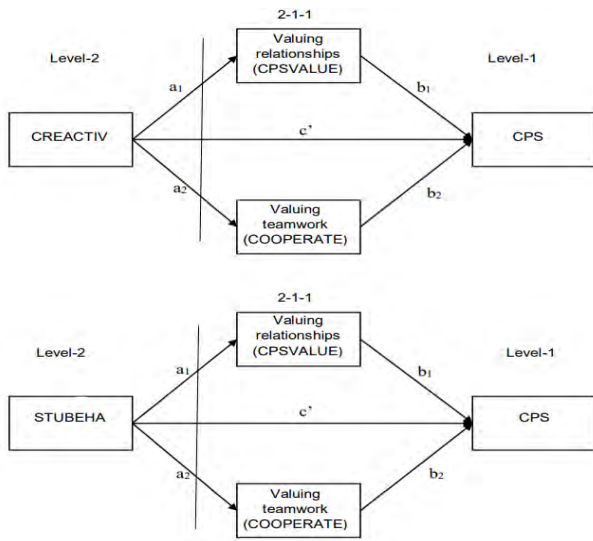
2.4. Data Analysis

Before the testing of mediation models, missing data assignment and removing outliers procedures were performed. Assignments were made for missing data using the expectation-maximization (EM) method. Following the missing data assignment and outlier analysis, the data analyses were performed over the data set of 5882 students from 187 schools.

It was checked out whether there was a multicollinearity problem, as the mediation analyses were based on regression models. In terms of the examination of the multicollinearity problem, the correlation between variables, tolerance, variance inflation factor (VIF), and condition index (CI) was also examined (Büyüköztürk, 2007; Çokluk et al., 2010; Field, 2009; Kalaycı, 2009). As a result, it is concluded that there is no multicollinearity problem.

Finally, the intra-class correlation coefficient (ICC) was examined to determine whether multilevel modeling was necessary. Tofighi and Thoemmes (2014) argue that if ICCs for level-1 variables in mediation models constructed with hierarchical data are greater than zero, then a multilevel model would give more accurate results. In the multilevel mediation models set within the scope of the research, the level-1 variables are composed of the scores of CPS, which is the dependent variable, and the indexes of valuing relationship (COOPERATE) and valuing teamwork (CPSVALUE), which are mediators. The intra-class correlation coefficient for the CPS scores was found as $\rho=0.51$. Accordingly, 51% of the differences between the CPS scores were due to the difference between schools, and 49% was due to the differences between students studying at the same school. Additionally, 1% of the differences regarding the students' valuing teamwork and 4% of the differences regarding their valuing relationships were due to differences between schools. In this case, it was decided to adopt a multilevel approach in the analysis of mediation models constructed with the independent variables (level-2 variables) of extracurricular creative activities and students' behavior hindering learning.

Multiple mediation models proposed for the first and second research questions were tested using the bootstrap method. The number of bootstrap samples generated within the scope of the research is 5000. While testing mediations with the bootstrap method, PROCESS macros in SPSS were used (Hayes, 2013; Preacher & Hayes, 2004).

As the data on extracurricular creative activities and students' behavior hindering learning mentioned in the third and fourth research questions were collected from school principals through the school questionnaire, these data constitute group-level data. The multilevel Structural Equation Model (MLSEM) was used to test multilevel mediation models set with

these variables. The approaches used in model estimation in MLSEM are basically categorized into two groups "within and between approach" and "full information-maximum likelihood". The MLR estimation method, which is considered under the full information-maximum likelihood approach, is used in the Mplus software (Muthen & Huberman, 2010; Heck & Thomas, 2015). MLR is robust to skewed distributions and calculates the chi-square test statistic when observations are dependent (Heck & Thomas, 2015). MLR estimation method was used in this study. The software package Mplus version 7.0 was used for MLSEM analysis.

In this study, the effect size values obtained through the ratio of indirect effect to the total effect, discussed in the section on ratio and proportion calculations, were used.

3. RESULTS

3.1. Results Regarding the Multiple Mediation Model Constructed with the Independent Variable of Sense of Belonging at School

In the multiple mediation model constructed with the independent variable of sense of belonging at school and the dependent variable of CPS scores, whether the variables of valuing teamwork and valuing relationships showed a mediation effect together was examined. In the mediation analysis, the bootstrap method was used, and the direct and total impact coefficients obtained as a result of the analysis are presented in Table 1.

Table 1. *Effect coefficients of multiple mediation model (1).*

| Parameter	B	S_B	t	p
a_1	0.092	0.013	6.945	0.000*
a_2	0.050	0.011	4.507	0.000*
b_1	8.650	0.913	9.470	0.000*
b_2	2.269	1.094	2.075	0.038*
c'	5.407	0.781	6.923	0.000*
c	6.312	0.788	8.007	0.000*

*$p<0.05$

The parameters a_1 and a_2 were unstandardized regression coefficients representing the effect between the sense of belonging at school and mediators of valuing relationships and valuing teamwork, respectively. The parameters b_1 and b_2 were unstandardized regression coefficients representing the effect between the mediators of valuing relationships and valuing teamwork and CPS scores, respectively. The parameters c and c' were parameters that indicated the total effect and direct effect between dependent and independent variables, respectively. Table 1 indicates the standard error values (SB) for the relevant effect coefficients and the t-values and significance levels for this effect. Accordingly, there was a positive and significant relationship between the sense of belonging at school and CPS scores (c=6.312, $t(5880)=8.007$, $p=0.000$). A one-unit increase in the sense of belonging at school variable caused an increase of 6.3124 in the CPS scores. Similarly, there was a positive significant relationship between the sense of belonging at school and valuing relationships ($a_1=0.092$, $t(5880)=6.945$, $p=0.000$) and valuing teamwork (a2=0.050, $t(5880)=4.507$, $p=0.000$). A one-unit increase in the independent variable caused an increase of 0.092 and 0.050 units in the mediators, respectively. When the effects of the mediators on the dependent variable were examined, a positive significant relationship was observed between the CPS scores and valuing relationships ($b_1=8.650$, $t(5880)=9.470$, $p=0.000$) and valuing teamwork (b2=2.269, t(5880)=2.075, $p=0.038$). A one-unit increase in the variable of valuing relationships caused an 8.6450-unit increase in the CPS scores, and the increase in the variable of valuing teamwork led to an increase of 2.269 units.

Hoyle and Kenny (1999) suggest that the power of the mediation test increases in mediation models when the coefficient b between the mediator and the dependent variable exceeds the coefficient a between the independent variable and the mediator. It is, therefore, important in

the selection of mediators, to select variables that have a relationship like b=a or b>a. As can be seen in Table 1, the effect coefficients in the first multiple mediation model constructed with the independent variable of sense of belonging at school are a_1=0.092, a2=0.050, b_1=8.650, and b2=2.269. In this case, since b>a, it can be stated that the mediators that have stronger relationships with the dependent variable compared to the independent variable are determined.

Figure 3 shows the model for the mediation effect of the variables of valuing teamwork and valuing relationships between the variables of CPS and the sense of belonging at school, and the effect coefficients in this model.

Figure 3. *Multiple mediation model (1) for the variable of attitude towards collaboration.*
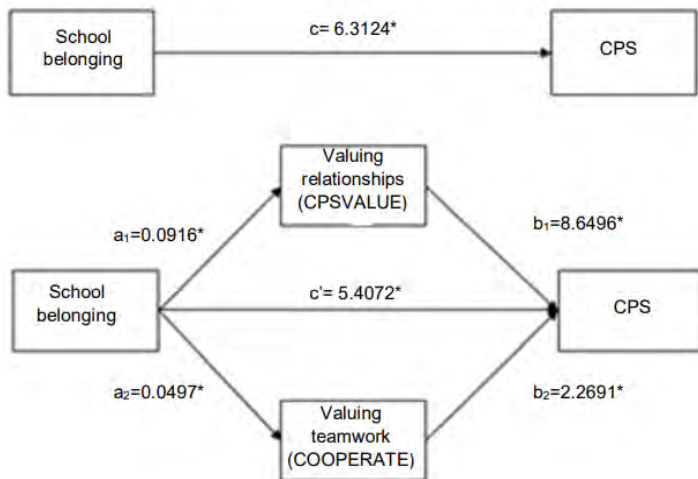
When the coefficient c (6.312) representing the total effect between the sense of belonging at school variable and the CPS variable and the coefficient c' (5.407) representing the direct effect between these two variables were compared, it was seen that under the influence of mediators, the predictive power of the sense of belonging at school variable on CPS scores decreased. This reduction in the mediator effect indicated partial mediation. The fact that the independent variable is no longer a significant predictor of the dependent variable under the control of the mediator is interpreted as full mediation, whereas the fact that the independent variable is still a significant predictor of the dependent variable but the effect decreases is interpreted as partial mediation (Baron & Kenny, 1986). Zhao et al. (2010) emphasized that it is insufficient to know the statistical significance of c and c' coefficients in order to determine whether there is or not, and that a comparison should be made between the coefficients. For this reason, the c'/c ratio was analyzed. It was observed that the relevant ratio was approximately 0.86. In other words, approximately 86% of the total effect was explained by the direct effect of the variables.

After direct and total effects, the indirect effects between the variables were examined. 95% confidence intervals for indirect effects were examined with 5000 bootstrap resamples (Preacher & Hayes, 2008). Table 2 shows the relevant results.

Table 2. *Indirect effect coefficients of multiple mediation model (1).*

Parameter	Effect	SE_{Effect}	95% Confidence Interval	
			Lower	Upper
$\sum ab$	0.905	0.167	0.590	1.258
a_1b_1	0.793	0.158	0.515	1.149
a_2b_2	0.113	0.064	0.011	0.267

Note. Bootstrap resample=5000

When Table 2 is examined, in terms of the sense of belonging at school and CPS score, it can be seen that the 95% confidence interval of the a_1b_1 indirect effect regarding the mediator of valuing relationships did not contain 0 (a_1b_1=0.793; CI= [0.515, 1.149]). It was observed that, in terms of the sense of belonging at school and CPS score, the 95% confidence interval of the indirect effect a_2b_2 related to the mediator of valuing teamwork did not contain 0, too (a_2b_2=0.113; CI= [0.011, 0.267]). Examining the 95% confidence interval for the total indirect effect between the dependent and independent variable, it was similarly found that it did not contain 0 ($\sum ab$= 0.905; CI= [0.590, 1.258]). The fact that confidence intervals for indirect effects do not contain 0 indicates that the mediation effect is confirmed (Jose, 2013; MacKinnon, 2008). In other words, the variables of valuing relationships and valuing teamwork considered within the scope of attitude towards collaboration together show a significant mediator effect in the model set with the sense of belonging at school and CPS scores.

Following the significance of the mediation effect, regarding the mediation effect of valuing teamwork and valuing relationships within the attitude towards collaboration, effect size values were obtained by the ratio and proportion approach. Accordingly, the mediation effect size, which was suggested by Jose (2013) and obtained through the ratio of indirect effect to total effect (ab/c), was computed. The ab/c ratio for the variables of valuing relationships and valuing teamwork were 0.126 and 0.018, respectively. These rates indicated that 13% of the total effect of the sense of belonging at school on the CPS scores was explained by the variable of valuing relationships, while 2% by the variable of valuing teamwork. As a result, the CPS skill scores of students who further feel a sense of belonging at school increased. 15% of this increase was explained by the fact that the sense of belonging at school increased students' attitudes towards collaboration.

3.2. Results Regarding the Multiple Mediation Model Constructed with the Independent Variable of Disciplinary Climate

In the multiple mediation model constructed with the independent variable of disciplinary climate and the dependent variable of CPS scores, it was examined whether the variables of valuing teamwork and valuing relationships showed a mediation effect together. The direct and total effect coefficients obtained in the mediation analysis are shown in Table 3.

Table 3. *Effect coefficients of multiple mediation model (2).*

| Parameter	B	S_B	t	p
a_1	0.169	0.016	10.680	0.000*
a_2	0.086	0.013	6.495	0.000*
b_1	8.115	0.913	8.887	0.000*
b_2	2.236	1.089	2.052	0.040*
c'	9.160	0.945	9.694	0.000*
c	10.726	0.947	11.356	0.000*

*$p<0.05$

There was a positive and significant relationship between disciplinary climate and CPS scores (c=10.726, $t_{(5880)}$=11.356, p=0.000). A one-unit increase in the disciplinary climate variable caused an increase of 10.726 units in the CPS scores. Similarly, there was a positive significant relationship between disciplinary climate and valuing relationships (a_1=0.169, $t_{(5880)}$=10.680, p=0.000) and valuing teamwork (a_2=0.086, $t_{(5880)}$=6.495, p=0.000). A one-unit increase in the independent variable caused an increase of 0.169 and 0.086 units in the mediators, respectively. Examining the effects of the mediators on the dependent variable, it was observed that there was a positive significant relationship between CPS scores and valuing relationships (b_1=8.115, $t_{(5880)}$=8.887, p=0.000) and valuing teamwork (b_2=2.236, $t_{(5880)}$=2.052, p=0.040). A one-unit increase in the variable of valuing relationships caused an increase of 8.115 units in the CPS

scores, while a one-unit increase in the variable of valuing teamwork led to an increase of 2.236 units, as well.

In the multiple mediation model set with the disciplinary climate independent variable and the CPS scores dependent variable, the effect coefficients were $a_1=0.169$, $a_2=0.086$, $b_1=8.115$, and $b_2=2.236$. In this case, it can be said that, as b>a, mediators that have stronger relationships with the dependent variable compared to the independent variable are determined. This increases the power of the mediation test regarding the model established (Hoyle & Kenny, 1999).

Figure 4 shows the model for the mediation effect of the variables of valuing teamwork and valuing relationships between the variables of CPS and the disciplinary climate, and it shows the effect coefficients in this model.

Figure 4. *Multiple mediation model (2) for the variable of attitude towards collaboration.*
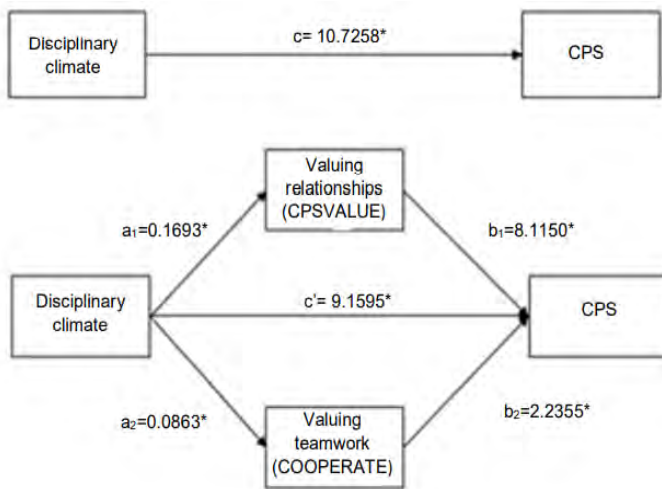
Comparing the coefficient c (10.726) representing the total effect between the disciplinary climate variable and the CPS variable and the coefficient c' (9.160) representing the direct effect between these two variables, it was observed that the predictive power of the disciplinary climate variable on the CPS scores decreased under the effect of the mediators. This decrease in the mediator effect points to partial mediation (Baron & Kenny, 1986). When the c'/c ratio was calculated, it was seen that 85% of the total effect was explained by the direct effect of variables. For the significance of indirect effects, 95% confidence intervals were examined with 5000 bootstrap resamples. Relevant results are given in Table 4.

Table 4. *Indirect effect coefficients of multiple mediation model (2).*

			95% Confidence Interval	
Parameter	Effect	SE_{Effect}	Lower	Upper
$\sum ab$	1.566	0.211	1.180	2.009
a_1b_1	1.374	0.211	0.995	1.841
a_2b_2	1.193	0.103	0.016	0.426

Note. Bootstrap resample=5000

When the indirect effects and confidence intervals in Table 4 were examined, it was observed that the mediation effect of the variable of valuing relationships, considered within the scope of attitude towards collaboration, between the disciplinary climate and CPS scores was confirmed. This was because the 95% confidence interval for the indirect effect a_1b_1 did not contain 0 ($a_1b_1=1.374$; CI= [0.995, 1.841]). It was seen that the confidence interval for the variable of valuing teamwork, considered within the scope of the attitude towards collaboration, did not contain the value 0, too ($a_2b_2=1.193$; CI= [0.016, 0.426]). Similarly, the confidence

interval for the total indirect effect did not contain 0 ($\sum ab=1.566$, CI= [1.180, 2.009]). This indicated that the mediation effect of the variables of valuing relationships and valuing teamwork, considered within the scope of the attitude towards collaboration, between the disciplinary climate independent variable and the dependent variable of CPS scores was significant.

The mediation effect size values obtained through the ratio of indirect effect to total effect (ab/c) for the variables of valuing relationships and valuing teamwork were found as 0.128 and 0.018, respectively. These rates indicated that 13% of the total effect of the discipline climate on the CPS scores was explained by the variable of valuing relationships, while 2% by the indirect effect set by the variable of valuing teamwork. As a result, students' CPS scores increased in the classrooms where a more positive discipline climate dominated according to students' opinions, whereas 15% of this increase was explained by the positive effect of the positive disciplinary climate on students' attitudes towards collaboration.

3.3. Results Regarding the Multilevel Mediation Model Constructed with the Independent Variable of Extracurricular Creative Activities

In the multilevel mediation model constructed with the independent variable of extracurricular creative activities and the dependent variable of CPS scores, it was examined whether the variables of valuing teamwork and valuing relationships showed a mediation effect together. In the multilevel mediation model constructed, the level-2 variable was composed of extracurricular creative activities, while the level-1 variable was composed of valuing relationships, valuing teamwork, and collaborative problem-solving skills. The multilevel mediation model was tested with MLSEM.

Unlike other multilevel mediation analysis methods, the multilevel structural equation model provides information on model fit. However, when the studies on multilevel mediation models that used the MLSEM method were examined, it is striking that no goodness of fit index for mediation models was reported and interpreted both in methodological and applied studies (Pham, 2017; Preacher et al., 2010, 2011; Tofighi & Thoemmes, 2014). Besides, as a result of the mediation analysis made on multilevel mediation models, the Mplus 7 program did not generate any modification indices. It is erroneous to establish a direct relationship between fit indices and the accuracy of the model. Fit indices are a verification process of how far the model deviates from the data. Fit indices do not provide any evidence for the significance of the results (Millsap, 2007). When viewed from this aspect, the multilevel mediation models constructed were interpreted by their direct and indirect effect coefficients.

Table 5 shows the direct effect coefficients for the multilevel mediation model, which was constructed with the independent variable of extracurricular creative activities (CREACTIV), the dependent variable of CPS, and the mediators of valuing teamwork (CPSVALUE) and valuing relationships (COOPERATE) that were considered within the scope of attitudes towards collaboration.
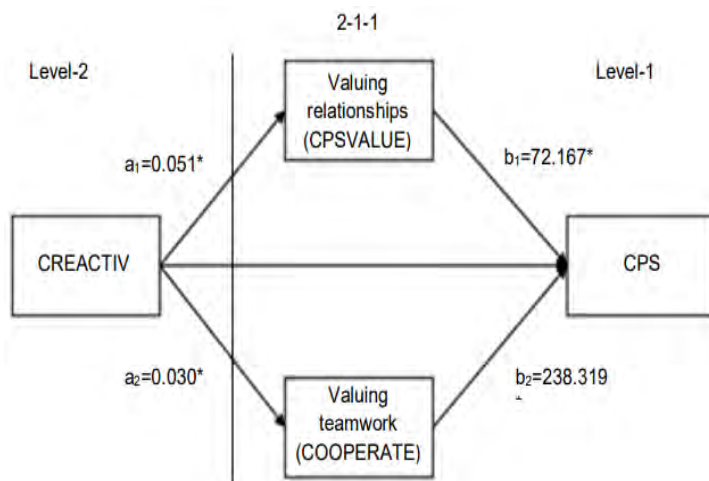
Table 5. *Direct effect coefficients for multilevel mediation model (1).*

Dependent Variable	Independent Variable	Parameter	Prediction (SE)	*p*
COOPERATE(M_1)	CREACTIV(X)	a_1	0.051 (0.022)	0.021*
CPSVALUE(M_2)	CREACTIV(X)	a_2	0.030 (0.013)	0.018*
CPS(Y)	COOPERATE(M)	b_1	72.167 (30.603)	0.018*
CPS(Y)	CPSVALUE(M_2)	b_2	238.319 (130.611)	0.068
CPS(Y)	CREACTIV(X)	c'	4.147 (6.038)	0.492

*$p<0.05$

When the relationships between the independent variable and mediators were examined in the between-group part of the model, it was seen that the variable of extracurricular creative activities (CREACTIV) predicted the variables of valuing relationships (COOPERATE) (a_1=0.051, p=0.021) and valuing teamwork (CPSVALUE) (a_2=0.030, p=0.018) significantly. A one-unit increase in the independent variable of extracurricular creative activities caused an increase of 0.051 and 0.030 units in the variables of valuing relationships and valuing teamwork, respectively. When the effect of the mediators on the dependent variable was examined, it was found that valuing relationships mediator predicted the CPS scores significantly (b_1=72.167, p=0.018), however, valuing teamwork mediator did not predict the CPS scores significantly (b_2=238.319, p=0.068). When the relationship between extracurricular creative activities under the effect of mediators and CPS scores was examined, it was found that extracurricular creative activities did not predict the CPS scores significantly (c'=4.147, p=0.492). In other words, it was observed that the direct effect of extracurricular creative activities at the between-group level on the students' CPS scores was insignificant. Figure 5 depicts the model on the mediation effect of the variables of valuing teamwork and valuing relationship between the variables of CPS and extracurricular creative activities, and it also shows the effect coefficients in this model.

Figure 5. *Multilevel mediation model (1) for the variable of attitude towards collaboration.*

The indirect effect coefficients and confidence intervals for the established mediation model are presented in Table 6.

Table 6. *Indirect effect coefficients for multilevel mediation model (1).*

Dependent Variable	Independent Variable	Parameter	Prediction (SE)	95% Confidence Interval	
				Lower	Upper
CPS(Y)	CREACTIV(X)	Indirect Effect (COOPERATE) a_1b_1	3.701 (2.283)	-0.773	8.175
CPS(Y)	CREACTIV(X)	Indirect Effect (CPSVALUE) a_2b_2	7.230 (5.153)	-2.870	17.329

The between-group indirect effects regarding the variables of valuing relationships (COOPERATE) and valuing teamwork (CPSVALUE) were 3.701 and 7.230, respectively. 95% confidence intervals for these indirect effects contained 0. This was interpreted as the variables

of valuing relationships and variable teamwork, discussed within the scope of attitude towards collaboration, did not show a significant mediation effect between extracurricular creative activities and the CPS scores.

3.4. Results Regarding the Multilevel Mediation Model Constructed with the Independent Variable of Students' Behaviour Hindering Learning

In the multilevel mediation model constructed, the level-2 variable consists of students' behavior hindering learning (STUBEHA), while level-1 variables consisted of valuing relationships (COOPERATE), valuing teamwork (CPSVALUE), and CPS scores. Table 7 shows the direct effect coefficients for the multilevel mediation model constructed.
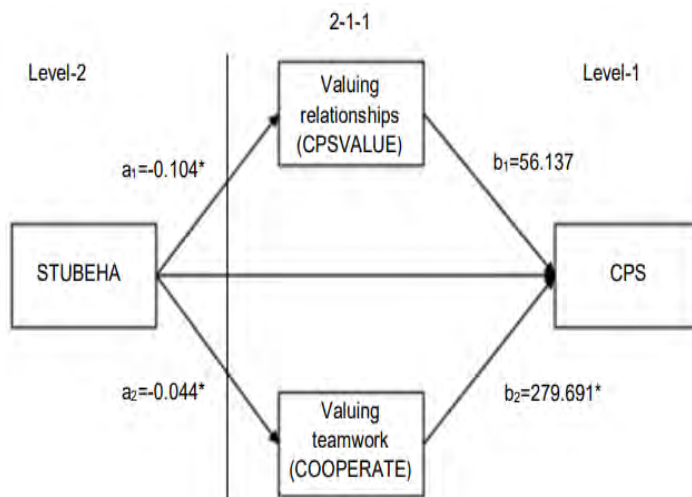
Table 7. *Direct effect coefficients for multilevel mediation model (2).*

Dependent Variable	Independent Variable	Parameter	Prediction (SE)	p
COOPERATE(M_1)	STUBEHA(X)	a_1	-0.104 (0.021)	0.000*
CPSVALUE(M_2)	STUBEHA (X)	a_2	-0.044 (0.016)	0.005*
CPS(Y)	COOPERATE(M)	b_1	56.137 (32.674)	0.086
CPS(Y)	CPSVALUE(M_2)	b_2	279.691 (143.706)	0.052
CPS(Y)	STUBEHA (X)	c'	-0.245 (7.166)	0.973

*$p<0.05$

When the relationships between the independent variable and mediators in the between-group part of the model were examined, it was observed that the independent variable of students' behavior hindering learning (STUBEHA) predicted the mediator of valuing relationships (COOPERATE) (a_1=-0.104, p=0.000) and mediator of valuing teamwork (CPSVALUE) (a_2=-0.044, p=0.005) significantly. A one-unit increase for the independent variable of students' behavior hindering learning caused a decrease of 0.104 and 0.044 units in the variables of valuing relationships and valuing teamwork, respectively. When the effect of mediators on the dependent variable was examined, it was seen that the variables of valuing relationships (b_1=56.137, p=0.086) and valuing teamwork (b_2=279.691, p=0.052) significantly did not predict the CPS scores. Examining the relationship between students' behavior hindering learning under the effect of mediators and the CPS scores, it was observed that students' behavior hindering learning did not significantly predicted the CPS scores similarly (c'=-0.245, p=0.973). Figure 6 depicts the model on the mediation effect of the variables of valuing teamwork and valuing relationship between the variables of CPS and students' behavior hindering learning, and it also shows the effect coefficients in this model.

Figure 6. *Multilevel mediation model (2) for the variable of attitude towards collaboration.*

The indirect effect coefficients and confidence intervals for the established mediation model are presented in Table 8.

Table 8. *Indirect effect coefficients for multilevel mediation model (2).*

Dependent Variable	Independent Variable	Parameter	Prediction (SE)	95% Confidence Interval	
				Lower	Upper
CPS(Y)	STUBEHA (X)	Indirect Effect (COOPERATE) a_1b_1	-5.859 (3.720)	-13.150	1.431
CPS(Y)	STUBEHA (X)	Indirect Effect (CPSVALUE) a_2b_2	-12.444 (6.986)	-26.137	1.249

The between-group indirect effects regarding the variables of valuing relationships (COOPERATE) and valuing teamwork (CPSVALUE) were -5.859 and -12.444, respectively. 95% confidence intervals for these indirect effects contained 0. This was interpreted as the variables of valuing relationships and variable teamwork, discussed within the scope of attitude towards collaboration, did not show a significant mediation effect between students' behavior hindering learning and the CPS scores.

4. DISCUSSION and CONCLUSION

In the multiple mediation model where the effect of sense of belonging at school on students' CPS skills was examined through attitudes towards collaboration, it was determined that the variable of attitude towards collaboration had a significant mediation effect between the sense of belonging at school and the CPS skills. As the students' sense of belonging at school increased, there was an increase in their CPS skills and 15% of this increase was explained by the fact that the sense of belonging at school positively affected students' attitudes towards collaboration. In the literature, there are research findings showing that there is a positive relationship between students' academic achievement and their sense of belonging at school (Adelabu, 2007; Anderman, 2002; Booker, 2004; Goodenow & Gardy, 1993; Roeser et al., 1996; Sarı, 2013; Sarı & Özgök, 2014). The influence of teachers and peers on students' sense of belonging at school is very important. Booker (2004) suggests that when students experience positive and supportive interactions with their friends and teachers, their sense of belonging at school increases. Roeser et al. (1996) found that positive interaction between teacher and student played an important role in increasing the positive effects of the school because it developed a sense of belonging at school. Students who feel accepted and approved by their peers and teachers take pleasure in attending school, in school activities and lessons more (Osterman, 2000, as cited in Sarı & Özgök, 2014). According to Adelabu (2007), students who feel a sense of belonging to school have higher levels of participation in social activities and academic work. The finding that school belonging is related to students' interactions with their teachers and peers is significantly related to interpersonal skills considered within the framework of CPS skills. Interpersonal skills are among the student characteristics that affect the achievements of individuals in collaborative problem-solving. In this context, it can be inferred that the sense of belonging at school also affects students' attitudes towards collaboration positively. Furthermore, it is thought that the increase in academic performance of students who feel a sense of belonging to the school is evidence of the effect of a sense of belonging at school on the problem-solving skills that constitute the cognitive dimension of the CPS.

The variable of attitude towards collaboration has a significant mediation effect between disciplinary climate and CPS skills. As the students' positive perceptions of the disciplinary climate in the classroom increase, there is also an increase in their CPS skills, and 15% of this increase is explained by the fact that the positive disciplinary climate positively affects students' attitudes towards collaboration. Attitudes of students in the classroom towards school and lessons, their study and listening habits, student-student and teacher-student interaction are important features that constitute the classroom climate (Erden, 1998). In this sense, the presence of a disciplined and fair learning environment in the classroom helps students acquire social skills at school that will facilitate them to establish healthy communication with their peers and teachers. In addition, there is a strong relationship between disciplinary climate and school belonging (Arum & Velez, 2012; Chiu et al., 2016; OECD, 2003, as cited in OECD, 2017e). An effective learning-teaching environment first requires individuals to communicate with each other healthily. Studies on the effect of disciplinary climate on academic achievement reveal that a positive disciplinary climate increases students' academic achievement (Akyüz & Pala, 2010; Örs-Özdil, 2017). Achieving and maintaining classroom discipline allows the teacher to spend less time on problems occurring in the classroom, concentrate more on the topics, and make lessons more effective. According to the findings obtained in this context, the fact that a positive disciplinary climate increases students' CPS scores is consistent with the situation in question. Given the effects of the disciplinary climate on the interaction between students, it can be considered that the CPS skill, in terms of its social dimension, has a positive relationship with the positive disciplinary climate. The fact that disciplinary climate affects CPS skills through attitude towards collaboration is thought to depend on students' ability to communicate with each other effectively in disciplined and fair learning environments and on not experiencing negativity in the division of responsibility for a task. Such an educational environment enables educating students who respect one another, have learned the culture of living together, and learned to be a team instead of a power struggle.

In multilevel mediation models where the effect of the independent variables of extracurricular creative activities and students' behavior hindering learning on the CPS skills are examined through the variable of attitude towards collaboration, on the other hand, it was determined that the attitude towards collaboration variable did not have a significant mediation effect. However, there is a negative relationship between students' behavior hindering learning and students' CPS skills, while there is a significant positive correlation between extracurricular creative activities and CPS skills. Students who spend more time at school through extracurricular and social activities can internalize their sense of belonging as well as improve their communication with each other. In this regard, extracurricular creative activities examined under PISA are effective in the development of students' social skills and academic achievements in schools, and thus, students' behavior hindering learning such as absenteeism, truancy, bullying, lack of respect, etc. are prevented (OECD, 2017c). Research on the characteristics of active schools indicates that a regular, supportive and positive environment in these schools. Activities such as sports, music and discussion clubs, etc. have an important role in building a supportive and positive school climate. These activities also enable students to develop their skills such as independence, compliance with guidelines, getting on well with authority figures and peers, etc. From this point of view, such activities carried out in schools are very important for the development of students' CPS skills, as they include the dimensions of leadership, communication and collaboration (OECD, 2017c). Besides, in a safe and healthy school climate, when negative behaviors such as violence, bullying, threats, and oppression are minimized, then it would be possible to educate students who respect one another, have learned the culture of living together, and manage to be a team instead of power struggle (Doğan, 2017). In this sense, it is thought that a decrease in negative student behavior would affect the students' CPS skills due to its social dimension. However, the findings obtained reveal that

extracurricular creative activities and students' behavior hindering learning, which was discussed within the scope of the research, did not have a direct and indirect significant effect on students' CPS skills through attitude towards collaboration. The probable reasons for this outcome may be due to the psychological characteristics of the variables in the mediation models constructed or the limitation of the number of mediators. Another probable reason may be the limitations of the PISA 2015 Turkey sample. In addition, the literature is open for improvement in terms of both methodological and application-oriented research for the use of MLSEM in mediation analysis.

Declaration of Conflicting Interests and Ethics

The authors declare no conflict of interest. This research study complies with research publishing ethics. The scientific and legal responsibility for manuscripts published in IJATE belongs to the authors.

Authorship Contribution Statement

The authors contributed equally to all the stages of the study.

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