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Concurrent Validity of the Central Examination of Secondary Education Institutions: Canonical Correlation Analysis

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Abstract
The aim of the study is to reveal the concurrent validity of the Central Examination of Secondary Education Institutions (OKMS). For this purpose, the relationship between the OKMS subtest raw scores of the students who took the exam and the 8th-grade year-end achievement scores of the courses within the scope of the exam was analyzed by canonical correlation analysis. Grade 8 achievement scores were taken as the independent (predictor) variable, and OKMS subtest scores were taken as the dependent (criterion) variable. The study was conducted on 3029 8th-grade students who took the OKMS. Only one canonical correlation was found to be significant between the two sets of variables. 8th-grade achievement scores were highly positively correlated with OKMS subtest scores. While 8th-grade foreign language and science achievement scores had a high predictive power for OKMS subtest raw scores, it was found that the predictive power of the achievement scores of the religious culture course in explaining the OKMS subtest raw scores was low. The set of 8th-grade scores explained 48.6% of the total variance in the variable set of OKMS subtest raw scores. The OKMS subtest variable set explains 60.1% of the total variance in the set of 8th-grade scores.

Keywords: Canonical correlation, Secondary education institutions central exam, Concurrent validity, Validity

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Introduction

It is feasible to instill behaviors in students that align with age expectations and to ensure the sustainability of these behaviors through education (Anıl, 2009). The outcomes derived from international comprehensive assessments such as PISA and TIMS have prompted reforms within our education system to equip our students for global competitiveness (MoNE, 2019a). Following international assessments, numerous countries, including Turkey, have introduced new forms of national assessments under the auspices of PISA (Stacey et al., 2015). In Turkey, this paradigm shift is evident in the High School Transition System, manifested through curriculum updates (MoNE, 2019a). Central exams are significant in facilitating students' transition to secondary education within our educational framework (MoNE, 2022a). Over the past 25 years, Turkey has implemented five distinct high school transition systems. These include the Transition to High Schools Examination (LGS) at the 8th-grade level from 1999 to 2003, the Secondary Education Institutions Examination (OKS) at the 8th-grade level from 2004 to 2006, the Level Determination Examination (SBS) spanning the 6th, 7th, and 8th grades from 2007 to 2013, the Transition from Basic Education to Secondary Education (TEOG) at the 8th-grade level from 2014 to 2017, and the Secondary Education Institutions Central Examination (OKMS) at the 8th-grade level since 2018 (Güler et al., 2019; MoNE, 2018a). OKS was discontinued due to students experiencing excessive stress and the limited scope of the exam; SBS was terminated as annual exams at a young age were found to impact students' psychology negatively; and TEOG was abolished as it required all students to undergo a rigorous exam schedule every semester of the eighth grade. Despite being designed as an achievement test, it was primarily used for selection purposes.

The Central Examination for Secondary Education Institutions is applied to select students for science high schools, Anatolian high schools, social sciences high schools, Anatolian imam hatip high schools, and secondary education institutions with special programs and projects. Central placement is made according to the quotas of the schools and the students' central exam score superiority (MoNE, 2018b; MoNE, 2021). Eighth-grade students are eligible to participate in the exam, which is structured around the learning objectives outlined in the 8th-grade curriculum. OKMS comprises two sessions, one held in the morning and the other in the afternoon. The morning session consists of a 50-question verbal section, while the afternoon session includes a 40-question numerical section. These sections are designed to assess students' abilities in reading comprehension, interpretation, inference, problem-solving, analysis, critical thinking, scientific processes, and skills, all aligned with the learning outcomes of the 8th-grade curriculum (MoNE, 2018c). Since 2018, the Central Exam has been designed following the PISA approach, with questions prepared to mirror PISA-style problems (Altun et al., 2022; MoNE, 2019a; Öztürk & Masal, 2020). The integration of PISA-type problems into the OKMS aims to familiarize both teachers and students with such problems and guide them in acquiring the necessary skills to solve them. An assessment of whether the changes and updates implemented in the high school transition system, aimed at placing students in secondary education institutions, meet the intended objectives is warranted. The efficacy of the measurement tool employed in central exams hinges on its reliability and validity (Turgut & Baykul, 2012). Investigating the effectiveness of these updates is a crucial matter.

The limited availability of quotas in secondary education institutions, coupled with high demand, necessitates the administration of selection exams. In the academic year 2017-2018, out of 1,192,799 Grade 8 graduates, 971,657 (81.46%) took the exam for 127,420 student quotas (MoNE, 2018c). In 2022, 1,236,308 students graduated from secondary school, with 1,031,799 participating in the central exam, resulting in 188,875 students being centrally placed in secondary education institutions. The placement rate in institutions admitting students through examination stands at approximately 19% (MoNE, 2022b). Given this context, the quality of centralized exam results, which gauge the academic proficiency of students seeking admission to institutions admitting through examination, holds paramount importance for decision-making concerning students (MoNE, 2022a).

Selection exams are designed to identify students possessing desired characteristics from among those with varying traits (Turgut & Baykul, 2014). Accurately pinpointing students through centralized exams is perceived as fulfilling the objectives of secondary education institutions and uncovering students' potential (Sınacı, 2019). Reliability and validity are critical attributes of any measurement tool. Reliability pertains to the extent to which measurements are devoid of errors. Meanwhile, validity concerns the degree to which a measurement tool effectively measures what it is intended to assess (Tan, 2015). Validity encompasses four categories: content validity, criterion-based validity, construct validity, and face validity (Büyüköztürk et al., 2010). Criterion-based validity is assessed through concurrent and predictive validity. Concurrent validity refers to the correlation between test scores and criterion scores, indicating the level of similarity or congruence between the test under evaluation and the accepted criterion (Büyüköztürk et al., 2010; Tan, 2015). Predictive validity gauges the extent

to which students' test scores forecast their future performance. In essence, predictive validity involves predicting future achievements. Since OKMS subtests align with the learning outcomes of the 8th-grade curriculum, it is hypothesized that OKMS subtest scores correlate with 8th-grade achievement scores, thereby serving as evidence of criterion-related validity for OKMS.

In the literature, in the validity studies of the central exams in our country, content validity (Çağlar & Kılıç, 2019; Gültekin & Arhan, 2015; Kelecioğlu et al., 2010), construct validity (Baş, 2013), predictive validity (Baş, 2013; Kan, 2005; Karakaya, 2007; Karakaya & Kutlu, 2002; Karakoç & Köse, 2018; Köroğlu & Doğan, 2022; Kelecioğlu, 2003; Köprülü, 2020; Önen, 2003; Öntaş et al., 2020; Özdemir & Gelbal, 2016; Parlak & Tatlıdil, 2013; Verim, 2006; Yakar, 2011), and concurrent validity (Baş, 2013; Deniz & Kelecioğlu, 2005; Doğan & Sevindik, 2011; Güzeller, 2005; Köroğlu & Doğan, 2022; Sevindik, 2009; Sınacı, 2019). Güzeller (2005) examined the relationship between the seventh grade academic achievement grade point averages and the subtest raw scores of the OKÖSYS with canonical correlation analysis. As a result of the study, it was concluded that there was a significant positive correlation between the seventh grade written exam scores and the 2002 OKÖSYS and that it adequately explained the variability in this exam. Doğan and Sevindik (2011) conducted a study to examine the concurrent validity between 6th grade Turkish, mathematics, social studies, science, and English academic achievement scores and the subtest scores of the placement test (SBS). The results showed that the concurrent validity of the exam was insufficient. Köroğlu and Doğan (2022) investigated the concurrent and predictive validity of the 2019 Central Examination for Secondary Education Institutions (OKMS) scores. The results showed that the predictive validity of OKMS subtest scores was high for 8th-grade Turkish and History and 9th grade History and Science academic achievement scores.

Purpose and Importance of the Research

There are a limited number of studies examining the concurrent validity of OKMS subtest scores. The questions asked in the central exam of secondary education institutions are achievement-oriented in the 8th-grade curriculum (MoNE, 2018a). It is considered necessary and important to reveal the relationship between students' 8th-grade year-end academic achievement scores and OKMS subtest scores. Student selection and placement exams from middle school to high school have an important place in the education system. It is of great importance that the central placements to be made according to the exam results are accurate and in line with the students' wishes (MoNE, 2022a). Examining the features of this critical examination and addressing any deficiencies will enhance the accuracy and effectiveness of decisions based on these exams. Therefore, there is a need to examine the relevance and validity of the OKMS. This study differs from other studies in terms of including all subtest scores of OKMS and the number of samples. It is thought that the results to be obtained from this study are important in terms of examining the quality of OKMS and determining the accuracy and appropriateness of the decisions made according to these exams.

The purpose of this study is to examine the relationship between the 2018 Central Examination for Secondary Education Institutions subtest raw scores and 8th-grade year-end academic achievement scores with canonical correlation analysis and to determine the level of concurrent validity of the exam. Since this study aims to reveal the relationship between academic achievement scores and OKMS subtest raw scores, it is a concurrent validity study. In line with this purpose, an answer to the question "How is the concurrent validity of the 2018 OKMS subtest scores?" was sought.

Method

Research Model

In this study, which examines the relationship between two sets of variables, each containing six variables, with multivariate canonical correlation analysis, a relational survey design was used. Concurrent validity was tried to be determined by applying canonical correlation analysis, one of the multivariate statistical techniques, to the variables obtained. Canonical correlation analysis aims to explain the relationship between two sets of variables (Albayrak, 2016; Karagöz; 2021; Tabachnick & Fidell, 2013). Canonical correlation analysis is a very important technique that determines the extent to which variation in one set of variables can be explained by variation in another set of variables (Sherry & Henson, 2005). It identifies canonical variables that reveal the highest correlation between two data sets and important underlying factors (Abdi et al., 2017).

Working Group

The research sample comprised 3029 8th-grade students who took part in the OKMS in 2018, selected through criterion sampling from 24 secondary schools across 17 districts within the boundaries of Bursa province (three

schools each from Osmangazi, Nilüfer, and Yıldırım central districts, two from İnegöl, and one from each of the remaining 13 districts). Necessary permissions and approvals were obtained prior to conducting the study. Criterion sampling involves examining situations that meet a predetermined set of criteria (Patton, 2014; Yıldırım & Şimşek, 2016). For canonical correlation analysis, the sample size should ideally be 20 times the total number of variables in the dataset (Karagöz, 2021). Given that there are 12 variables in total in this study, a minimum of 240 participants is deemed adequate for the sample. The distribution of students across schools is presented in Table 1.

Table 1. Distribution of the students participating in the study according to schools

Schools	N	%		N	%
Secondary School 1	49	1.62	Secondary School 13	139	4.59
Secondary School 2	75	2.48	Secondary School 14	125	4.13
Secondary School 3	164	5.41	Secondary School 15	45	1.49
Secondary School 4	161	5.32	Secondary School 16	119	3.93
Secondary School 5	139	4.59	Secondary School 17	165	5.45
Secondary School 6	55	1.82	Secondary School 18	167	5.51
Secondary School 7	261	8.62	Secondary School 19	105	3.47
Secondary School 8	41	1.35	Secondary School 20	88	2.91
Secondary School 9	141	4.66	Secondary School 21	73	2.41
Secondary School 10	85	2.81	Secondary School 22	203	6.70
Secondary School 11	156	5.15	Secondary School 23	78	2.58
Secondary School 12	138	4.56	Secondary School 24	257	8.48
Total				3029	100

Obtaining the Data

The data utilized in the study consisted of the 2018 OKMS sub-test raw scores and the 8th-grade year-end achievement scores (expressed in the hundredth system) of the same cohort of students for each subject, sourced from the e-school system of the respective schools. Each student's raw score for every OKMS subtest was calculated by subtracting one-third of the number of incorrect answers from the total number of correct answers in the subtest (MoNE, 2018a). In the 2018 OKMS, the verbal section comprised 50 questions (20 Turkish, 10 religious culture, 10 history, and 10 foreign languages), while the numerical section comprised 40 questions (20 mathematics and 20 science) (MoNE, 2018c). Aligned with the 8th-grade curriculum, OKMS was administered in two sections, numerical and verbal, encompassing a total of 90 multiple-choice questions. The first section, comprising 50 verbal questions, was allotted 75 minutes, whereas the second section, containing 40 numerical questions, was allocated 60 minutes (MoNE, 2018c). Regarding course assessment, a course's semester score is determined by computing the arithmetic average of the student's scores from exams, participation in course activities, and any projects assigned. The year-end score of a course is calculated as the arithmetic average of the first and second semester scores (MoNE, 2014).

Analysis of Data

Canonical correlation analysis was used to reveal the relationship between students' 8th-grade achievement scores and OKMS subtest scores. Grade 8 achievement scores in Turkish, mathematics, science, history, foreign language, and religious culture constitute independent (predictor) variables set 1, and OKMS subtest scores constitute dependent (criterion) variables set 2. Both data sets consist of six variables each, and the diagram of the canonical correlation analysis for sets 1 and 2 is shown in Figure 1.

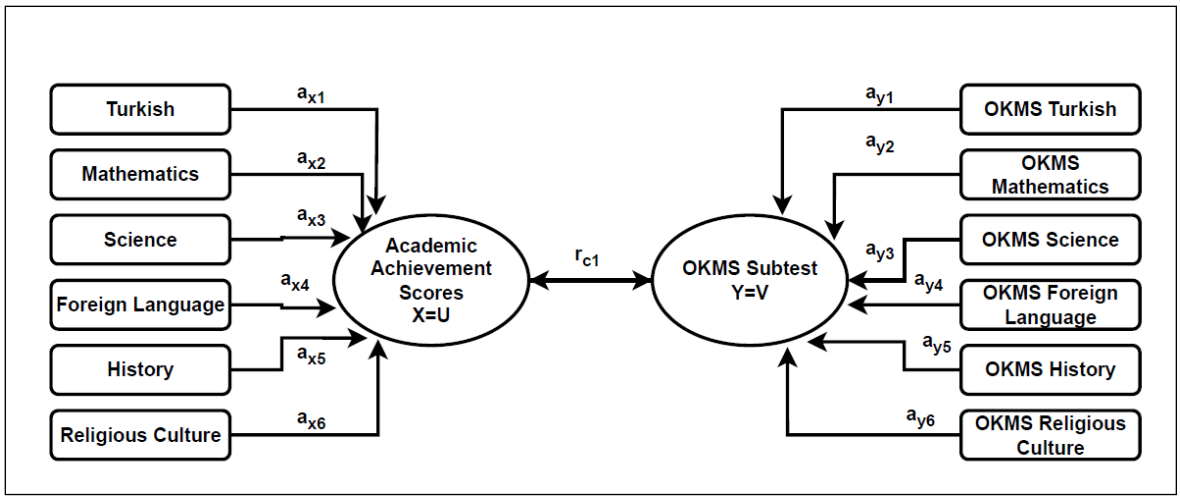

Figure 1. Canonical correlation diagram

According to Figure 1, a_{x1}, a_{x2}, a_{x3}, a_{x4}, a_{x5}, and a_{x6} represent the canonical loadings of the independent (X) variable, a_{y1}, a_{y2}, a_{y3}, a_{y4}, a_{y5}, and a_{y6} represent the canonical loadings of the dependent (Y) variable, and r_{c1} represents the relationship between the dependent and independent canonical variables.

In order to conduct canonical correlation analysis, it is necessary to test the assumptions that the variables belong to two data sets, whether the data set has extreme data, whether it is linear, whether there is multiple normal distributions and whether there is multiple linear connections, and whether the number of data points is at least 20 times the total number of variables (Karagöz, 2021; Küçüksille, 2016; Tabachnick & Fidell, 2013). All analyses of the data were conducted using SPSS 26.0. First, multicollinearity among independent (predictor) variables and multivariate normal distributions of scores were examined. Correlations between variables were examined for multiple. If the correlation value between variables is above 0.80, it indicates that there may be multicollinearity, and if it is above 0.90, it indicates that there may be a serious multicollinearity problem (Büyüköztürk, 2012). In addition, a tolerance value (TD) greater than 0.10 and a variance inflation factor (VIF) value less than 10 indicate that there is no multicollinearity problem (Büyüköztürk, 2012; Çokluk et al., 2016). The TD and VIF values for the variables are given in Table 2.

Table 2. Tolerance value and VIF values for variables

Variables	Courses	TD	VIF
8th grade	Turkish	.344	2.909
	Mathematics	.248	4.033
	Science	.206	4.863
	Foreign Language	.301	3.318
	History	.317	3.150
	Religious Culture	.429	2.329
OKMS	OKMS Turkish	.388	2.574
	OKMS Mathematics	.647	1.545
	OKMS Science	.449	2.225
	OKMS Foreign Language	.485	2.062
	OKMS History	.552	1.812
	OKMS Religious Culture	.626	1.597

When Table 2 is examined, it is seen that TD values greater than 0.10 and VIF values less than 10 meet the criteria that there is no multicollinearity problem. In addition, according to Table 4, the correlation coefficients were examined, and it was decided that there was no multicollinearity problem. Then, it was examined whether the data were univariately normally distributed. A skewness coefficient between -1.5 and +1.5 indicates that the data are normally distributed (Tabachnick & Fidell, 2013). According to Table 3, it was seen that the data were univariately normally distributed. In assessing multivariate normality, scatter diagrams were examined, revealing that each distribution closely approximated an ellipse. For the homoscedasticity, Box's M was examined, and it is seen that the assumption of homoscedasticity regarding the variables was met ($p>.05$). In this study, the complete data of 3357 students was accessed, the extreme values of the data set were examined, 328 student data were excluded from the analysis, and 3029 student data were used in the analysis. It was determined that the assumptions of canonical correlation analysis were met, and the application was started.

Results

Descriptive statistics for the variables of the 8th-grade courses and OKMS subtests are given in Table 3.

Table 3. Descriptive statistics for academic achievement scores and OKMS subtest scores

Variables	N	Min	Max	Mean	Standard Deviation	Skewness	Kurtosis
Turkish	3029	26.60	100	77.79	14.86	-.57	-.38
Mathematics	3029	14.20	100	68.14	22.58	-.24	-1.11
Science	3029	19.80	100	74.66	16.95	-.46	-.68
Foreign Language	3029	18.80	100	73.21	19.59	-.50	-.76
History	3029	20	100	75.50	17.27	-.52	-.58
Religious Culture	3029	37	100	86.25	11.28	-1.10	1.04
OKMS Turkish	3029	-2.66	20	12.29	4.55	-.41	-.42
OKMS Mathematics	3029	-5.66	11.66	2.39	3.39	.52	-.23
OKMS Science	3029	-5.33	20	7.65	4.78	.09	-.69
OKMS Foreign Language	3029	-3	10	4.84	3.42	-.00	-1.18
OKMS History	3029	-.33	10	7.59	2.37	-.91	.05
OKMS Religious Culture	3029	4.66	10	9.02	1.40	-1.43	1.19

According to Table 3, the highest average in the 8th-grade course variable belongs to the religious culture course with 86.25, followed by Turkish with 77.79, history with 75.50, science with 74.66, and foreign language with 73.21. The lowest average belongs to mathematics, with 68.14. In the variables of the OKMS subtests, it was determined that the highest average among the subtests with 20 questions belonged to Turkish with 12.29 and the lowest average belonged to mathematics with 2.39. In the subtests with 10 questions, the highest success was in the religious culture subtest with 7.59, and the lowest success was in the foreign language subtest with 4.84. When the skewness and kurtosis coefficients are analyzed, it is seen that the skewness values are between -1.43 and 0.52 and the kurtosis values are between -1.18 and 1.19.

The correlations of the variable sets included in the canonical correlation analysis, both within and between the sets, are given in Table 4.

Table 4. Correlations between variables

	Turkish	Mathematics	Science	Foreign Language	History	Religious Culture	OKMS Turkish	OKMS Mathematics	OKMS Science	OKMS Foreign Language	OKMS History	OKMS Religious Culture
Turkish	1	.74**	.74**	.73**	.70**	.64**	.69**	.50**	.60**	.62**	.52**	.53**
Mathematics	.74**	1	.84**	.73**	.72**	.64**	.68**	.59**	.66**	.62**	.52**	.49**
Science	.74**	.84**	1	.78**	.75**	.68**	.69**	.56**	.71**	.66**	.56**	.53**
Foreign Language	.73**	.73**	.78**	1	.74**	.66**	.67**	.50**	.62**	.78**	.53**	.50**
History	.70**	.72**	.75**	.74**	1	.70**	.67**	.48**	.62**	.62**	.62**	.52**
Religious Culture	.64**	.64**	.68**	.66**	.70**	1	.61**	.40**	.54**	.55**	.52**	.55**
OKMS Turkish	.69**	.68**	.69**	.67**	.67**	.61**	1	.51**	.66**	.65**	.60**	.56**
OKMS Mathematics	.50**	.59**	.56**	.50**	.48**	.40**	.51**	1	.53**	.50**	.39**	.30**
OKMS Science	.60**	.66**	.71**	.62**	.62**	.54**	.66**	.53**	1	.62**	.56**	.48**
OKMS Foreign Language	.62**	.62**	.66**	.78**	.62**	.55**	.65**	.50**	.62**	1	.52**	.44**
OKMS History	.52**	.52**	.56**	.53**	.62**	.52**	.60**	.39**	.56**	.52**	1	.50**
OKMS Religious Culture	.53**	.49**	.53**	.50**	.52**	.55**	.56**	.30**	.48**	.44**	.50**	1

**p<0.01

When Table 4 is analyzed, it is found that all correlations between the variables are positive and significant at the .01 level. When the correlations between the independent variables, i.e., 8th-grade achievement scores, are examined, the highest correlation is between mathematics and science at the level of .84, and the lowest correlation is between religious culture and Turkish at the level of .64. Regarding the dependent variables, the highest correlation was between science and Turkish at the level of .66, and the lowest correlation was between religious culture and mathematics at the level of .30. When the relationship between independent variables and dependent variables is examined, it is seen that the highest correlation is .78 between foreign language courses and the lowest correlation is .40 between the 8th-grade religious culture course and the OKMS mathematics subtest.

Table 5 presents the summary results of the canonical correlation analysis between the dependent and independent variables. Table 5 shows the first canonical correlation coefficients, which are significant for the model and have the highest canonical correlation coefficient. In addition, total variance and total redundancy values are also given in the table. Total redundancy reveals what percentage of the variability in the relevant variable set is explained by the other variable set (Karagöz, 2021; Tabacnick & Fidell, 2013).

Table 5. Summary results of canonical correlation analysis

		I.Set Grade 8 year-end academic achievement scores	II. Set OKMS subtest raw scores
Number of variables		6	6
Total variance		%100	%100
Total redundancy		%60.1	%48.6
Variables	1	Turkish	OKMS Turkish
2		Mathematics	OKMS Mathematics
3		Science	OKMS Science
4		Foreign Language	OKMS Foreign Language
5		History	OKMS History
6		Religious Culture	OKMS Religious Culture

When Table 5 is examined, the total variance ratio obtained for the six variables is 100% in the 8th-grade year-end academic achievement scores set and 100% in the OKMS subtest raw scores set. 60.1% of the variance of the 8th-grade year-end academic achievement scores set is explained by the OKMS subtest raw scores variable set. 48.6% of the variance in the OKMS subtest raw scores variable set is explained by the 8th-grade year-end academic achievement scores variable set. According to the table, the 8th-grade academic achievement scores set is explained at a higher rate than the OKMS subtest raw scores variable set.

Table 6 presents the results of the canonical correlation analysis conducted to examine the relationship between the 8th-grade year-end academic achievement scores and the raw scores of the OKMS subtest.

Table 6. Results of canonical correlation analysis

	Canonical Correlation	Canonical R^2	Eigenvalue	Wilks Lambda	F	df	Error df	p
1	.873	.76	3.21	.162	189.197	36	13251.33	.00
2	.443	.19	.244	.681	48.774	25	11212.87	.00
3	.308	.09	.105	.848	32.077	16	9223.83	.00
4	.194	.03	.039	.936	22.397	9	7350.03	.00
5	.149	.02	.023	.973	20.777	4	6042.00	.00
6	.071	.005	.005	.995	15.147	1	3022.00	.00

According to Table 6, since there are 6 different variables in each variable set of the canonical correlation analysis, 6 different canonical correlation pairs emerged. It is seen that all canonical correlation pair coefficients are statistically significant ($p<$ .00). Accordingly, according to the first canonical correlation between the 8th-grade year-end achievement grades and the variable sets of the OKMS subtests, there is a high linear relationship at the level of .87 between the 8th-grade and the OKMS subtest scores. The square of the canonical correlations gives the common variance explained between the data sets. The first pair of canonical variables in Table 6 explains 76% of the common variance, while the others explain 19%, 9%, 3%, 2%, and 0.5%, respectively. Hence, although all canonical coefficients are significant, the first canonical correlation pair is statistically more significant.

In order to decide which of the canonical correlation coefficients are practically important, the graph of eigenvalues in Figure 2 was prepared.

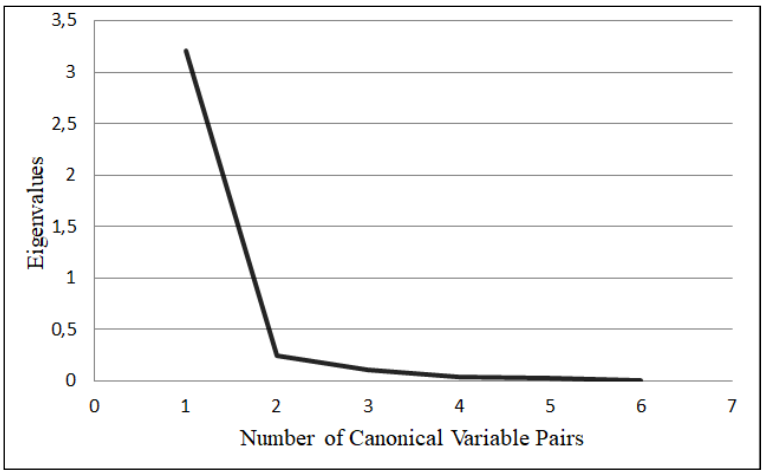

Figure 2. Eigenvalues plot for pairs of canonical variables in the data sets

When the eigenvalues in Figure 2 are analyzed, it is seen that the eigenvalue of the first canonical pair is quite high and the others decrease rapidly. This shows that the first canonical correlation coefficient gives more significant results than the other five canonical correlation coefficients.

Table 7 shows the standardized linear canonical correlation coefficients obtained for each of the variables. Since there were 6 independent and 6 dependent variables in the canonical correlation analysis, 6 canonical variable pairs were obtained as a result of the analysis. From the independent variable set of 8th-grade academic achievement scores, U1, U2, U3, U4, U5, U6, and from the dependent variable set of OKMS subtest scores, V1, V2, V3, V4, V5, and V6 canonical variables were obtained. According to the results of the canonical correlation analysis, since the first canonical correlation coefficients were statistically significant considering the explained variance and eigenvalues, canonical variable pairs U1 and V1 were interpreted. The standardized canonical coefficients of the canonical variable pairs in Table 6 indicate the standard deviation type of variation in the canonical variable with a one standard deviation increase in the independent variables.

Table 7. Standardized for dependent and independent variables, canonical correlation coefficients

Independent variables/Set 1	U1	U2	U3	U4	U5	U6
Turkish	-.17	.22	-.32	-.99	-.57	-1.18
Mathematics	-.15	.34	1.05	-.27	-1.10	1.21
Science	-.20	.56	.60	.37	1.81	-.83
Foreign Language	-.35	-1.76	.08	.15	-.06	.19
History	-.14	.55	-.73	1.35	-.63	-.18
Religious Culture	-.08	.18	-.83	-.70	.52	.90
Dependent variables/Set 2	V1	V2	V3	V4	V5	V6
OKMS Turkish	-.29	.31	-.17	-.69	-.85	-1.07
OKMS Mathematics	-.14	.28	.67	-.08	-.57	.80
OKMS Science	-.19	.47	.63	.30	1.12	-.43
OKMS Foreign Language	-.37	-1.36	-.02	.16	.09	.13
OKMS History	-.09	.34	-.65	1.05	-.29	.23
OKMS Religious Culture	-.15	.13	-.50	-.71	.50	.72

According to Table 7, the first canonical variables were obtained for the 8th-grade academic achievement scores and OKMS datasets. The linear equations of the pair of variables estimating the maximum relationship are given below.

$$U1 = (-.17) * Turkish + (-.15) * Mathematics + (-.20) * Science + (-.35) * Foreign\ Language + (-.14) * History + (-.08) * Religious\ Culture$$

$$V1 = (-.29) * OKMS\ Turkish + (-.14) * OKMS\ Mathematics + (-.19) * OKMS\ Science + (-.37) * OKMS\ Foreign\ Language + (-.09) * OKMS\ History + (-.15) * OKMS\ Religious\ Culture$$

According to these equations, the most influential variable in the formation of U1 and V1 canonical variables is the 8th-grade foreign language course with -.35 and OKMS foreign language with -.37. The least effective variable in the formation of U1 and V1 canonical variables is the 8th-grade religious culture academic achievement score

variable with -.08 and the -.09 score obtained from the OKMS history subtest. Then, it is seen that the effective variables in the formation of the U1 canonical variable are science with -.20, Turkish with -.17, mathematics with -.15, history course with -.14, and the effective variables in the formation of the V1 canonical variable are OKMS Turkish with -.29, OKMS science with -.19, OKMS religious culture with -.15, and OKMS mathematics with -.14.

Table 8 presents the canonical loadings and cross-loadings of the 8th-grade year-end academic achievement score and OKMS subtest raw score variable sets. Canonical loadings indicate the relationship between canonical variables and each original variable within its own cluster (Sevindik, 2009). When the canonical loadings of the dependent and independent variable sets are negative, it means that a decrease in one variable is associated with a decrease in the other variable, which allows all of them to be interpreted as positive (Özdemir & Gelbal, 2014).

Table 8. Canonical and cross-loadings for dependent and independent variables

	Canonical Loads	Cross Loads		Canonical Loads	Cross Loads
Independent variables	U1	V1	Dependent variables	V1	U1
Turkish	-.86	-.75	OKMS Turkish	-.87	-.76
Mathematics	-.88	-.76	OKMS Mathematics	-.66	-.58
Science	-.91	-.80	OKMS Science	-.81	-.71
Foreign Language	-.92	-.80	OKMS Foreign Language	-.87	-.76
History	-.86	-.75	OKMS History	-.70	-.61
Religious Culture	-.78	-.68	OKMS Religious Culture	-.66	-.58

According to Table 8, according to the canonical and cross-loadings calculated between the 8th-grade and OKMS, the highest factor loading in the formation of the U1 canonical variable belongs to the 8th-grade foreign language course at the level of .92 and the lowest factor loading belongs to the 8th-grade religious culture course at the level of .78. When the cross-loadings are analyzed, it is seen that the 8th-grade foreign language course with .80 and the science course with .80 made the greatest contribution to the V1 canonical variable. In other words, the correlation between the V1 linear component of the OKMS subtest scores and the academic achievement scores of the 8th-grade foreign language and science courses is high. When the role of 8th-grade academic achievement scores in explaining the OKMS subtest scores is analyzed, it is seen that the academic achievement scores of 8th-grade foreign language and science courses come to the forefront. Again, when the canonical and cross-loading values between OKMS subtest scores and 8th-grade academic achievement scores are analyzed, it is seen that OKMS Turkish and OKMS foreign language courses made the biggest contribution to the formation of the V1 canonical variable with .87. When the cross-loadings are analyzed, the most important contribution to the U1 canonical variable is made by OKMS Turkish and OKMS foreign language courses with .76. However, when the role of OKMS subtest scores in explaining 8th-grade academic achievement scores is analyzed, the scores of OKMS Turkish and OKMS foreign language courses come to the forefront.

The calculated relationships of the canonical correlations of the first canonical pair between the dependent and independent variables are shown in Figure 3.

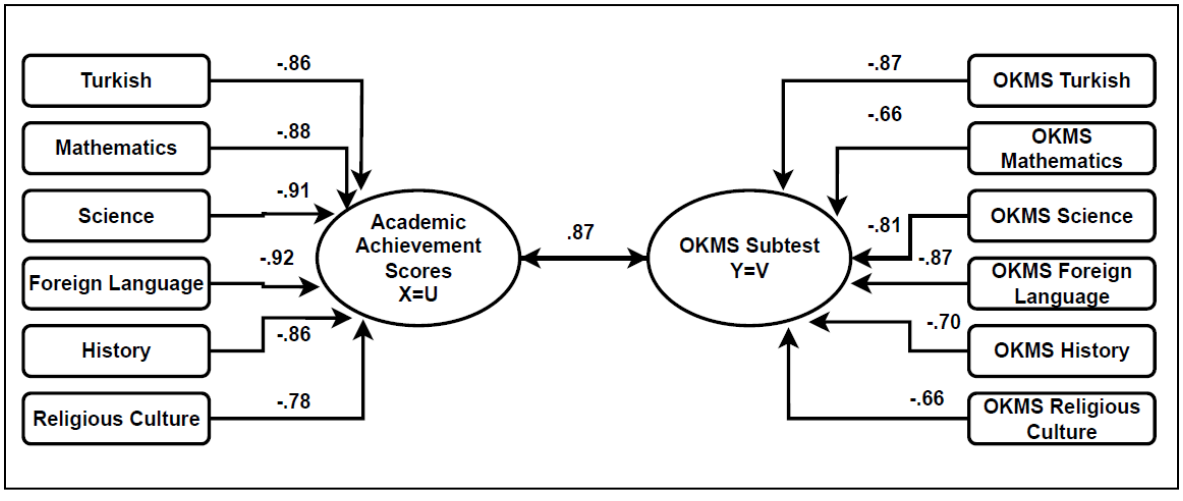

Figure 3. Summary of canonical correlation relationships

When Figure 3 is examined, it is seen that the canonical correlation value between the 8th-grade academic achievement scores and OKMS subtest data sets is .87. In terms of the canonical correlation relationships of the variables in Set 1, from the largest to the smallest value, foreign language (-.92), science (-.91), mathematics (-.88), Turkish and history (-.86), and religious culture (-.78) variables are interpreted as part of Set 1. In terms of the canonical correlation relationships of the variables in the second set, OKMS Turkish and OKMS foreign language (-.87), OKMS science (-.81), OKMS history (-.70), and OKMS mathematics and OKMS religious culture (-.66) variables are considered part of this set.

For the first model, the variance values and redundancy coefficients obtained for the variables 8th-grade year-end academic achievement scores (independent) and OKMS subtest raw scores (dependent) are given in Table 9.

Table 9. Variances and redundancy coefficients of variables

Grade 8 academic year-end achievement scores			OKMS Subtest Scores		
Canonical variables	Variance explained	Redundancy coefficient	Canonical variables	Variance explained	Redundancy coefficient
U1	.76	.58	V1	.59	.45
U2	.05	.01	V2	.08	.02
U3	.06	.01	V3	.11	.01
U4	.05	.00	V4	.08	.00
U5	.03	.00	V5	.07	.00
U6	.05	.00	V6	.07	.00
Total	1	0.60		1	0.48

When Table 9 is examined, 48% of the variance in the OKMS variable set is explained by the 8th-grade variables. The contribution of the U1 canonical variable to its own variable set is 76%, and the variance explained by the OKMS variable set is 58%. 60% of the variance in the 8th-grade course set is explained by the OKMS variables. In the variable set of OKMS subtest scores, the contribution of the V1 canonical variable to its own variable set is 59%, and the variance explained by the 8th-grade variable set is 45%. These results show that there is a high correlation between Grade 8 and OKMS variable sets. In addition, according to the table, it is seen that the U1 and V1 canonical variable pairs have a sufficient contribution to the variance, and the contribution of other canonical pairs to the variance is very weak.

Conclusion and Discussion

In this study, the relationship between 2018 Secondary Education Institutions Central Examination subtest raw scores and 8th-grade year-end academic achievement scores was examined with canonical correlation analysis.

The relationship between OKMS 2018 Turkish, mathematics, science, foreign language, history, and religious culture subtest scores and 8th-grade year-end academic achievement scores could be explained by a single canonical variable pair. This finding can be explained by a single pair of canonical variables. This finding is in line with the relationship between seventh grade course achievement grade point averages and 2002 subtests in the Secondary Education Institutions Student Selection and Placement Examination (OKÖSYS) (Güzeller, 2005), the relationship between sixth grade school subjects and sixth grade SBS 2008 subtest scores (Doğan & Sevindik, 2011), and the relationship between eighth grade year-end academic achievement scores and 8th-grade year-end academic achievement scores. Grade 8 academic achievement scores and 8th-grade SBS 2012 subtest scores (Parlak & Tatlıdil, 2013), and the relationship between 8th-grade year-end achievement scores and scores in the OKMS 2019 subtests (Köroğlu & Doğan, 2022) with a single pair of canonical variables.

Another finding of the study was that there was a high positive relationship between 8th-grade academic achievement scores and OKMS subtest scores, and the contribution of this canonical variable pair to the common variance was .76. An increase in 8th-grade academic achievement scores leads to an increase in OKMS subtest scores. As the 8th-grade academic achievement scores of the students increase, it is expected that the OKMS subtest scores will also increase. This result can be interpreted as indicating that the increase in students' school achievement scores will also increase their OKMS achievement scores. Similar to the results of the study, a high positive correlation between students' school achievement scores (OBP) and central exam scores was found in MoNE's reports (MoNE, 2018c, 2019b, 2020, 2022a). Similarly, in many studies in the literature, it has been found that there is a highly significant relationship between academic achievement scores and central exam subtest scores (Atasayar, 2019; Demir, 2022; Deniz, 2003; Doğan & Sevindik, 2011; Güzeller, 2005; Köroğlu & Doğan, 2022; Öntaş et al., 2020; Parlak & Tatlıdil, 2014; Sarı, 2019; Sevindik, 2009). Parlak and Tatlıdil (2014) examined the relationship between the scores of the Placement Test (SBS) for 8th graders and school achievement scores with

canonical correlation and found that there was a significant high linear relationship between test scores and school achievement scores. In fact, there is a strong relationship between students' academic achievement and their subtest test scores. Similarly, it is emphasized that students' prior knowledge has an important contribution to the learning process (Baş, 2013; Güzeller, 2012; Kan, 2005; Sınacı, 2019). Since both school academic achievement and OKMS questions measure the 8th-grade curriculum outcomes, it is expected that the results will be related. It is thought that the auxiliary resources, such as sample questions and study questions, that the Ministry has been preparing and publishing every month for students to prepare for the OKMS since 2018 (MoNE, 2022a), support this process.

According to the standardized canonical correlation between the two sets, it was determined that the predictive power of the 8th-grade foreign language and science courses was high, while the predictive power of the academic achievement scores of the religious culture course was low in explaining the OKMS subtest raw scores. While there are studies that support the findings of this study (Güzeller, 2005; MoNE, 2019b), there are studies that differ (Doğan & Sevindik, 2011; Köroğlu & Doğan, 2022; MoNE, 2020; Parlak & Tatlıdil, 2014; Sevindik, 2009). Güzeller (2005) examined the relationship between academic achievement scores in primary school seventh grade courses and OKÖSYS subtests with canonical correlation analysis and found that science courses made the most important contribution to the set of course variables. Sevindik (2009) examined the concurrent validity of SBS and found that the variable that predicted academic achievement in the 6th and 7th grade SBS subtests at a low level belonged to the foreign language course. Parlak and Tatlıdil (2014), in their study on the concurrent validity of the SBS for 8th graders, determined that although the predictive validity of mathematics and Turkish courses was high, the predictive validity of English courses was low. Köroğlu and Doğan (2022) found that the lowest predictor variable in explaining the OKMS subtest scores was the 8th-grade foreign language course. Considering that the sample size and homogeneity of the groups are effective in the studies, this study differs from other studies in terms of including 3029 students from 24 different secondary schools. Based on the findings of the study, it can be said that an increase in foreign language and science courses in the set of course variables will lead to an increase in other courses. In addition, the low predictive power of the religious culture course in explaining the OKMS subtest raw scores can be explained by the course hours and the number of questions.

As a result of the research, the 8th-grade year-end academic achievement scores explained 48.6% of the total variance in the set of variables of OKMS subtest raw scores. Likewise, the variable set of OKMS subtest raw scores explains 60.1% of the total variance in the set of 8th-grade year-end academic achievement scores. The fact that 8th-grade courses explain 48.6% of the variance in OKMS indicates that as students' academic achievement increases, their test scores may also increase. These explained variances are at a level that can be considered sufficient. According to this rate, it is possible to say that OKMS, which was prepared according to the secondary school curriculum, serves its purpose. It can be said that 8th-grade course achievement scores can predict OKMS subtest raw scores sufficiently. In other words, it is possible to say that the concurrent validity of OKMS scores is at a sufficient level. This result of the study is similar to the results of Deniz (2003), Doğan and Sevindik (2011), Güzeller (2005), Köroğlu and Doğan (2022), and Parlak and Tatlıdil (2014). Güzeller (2005) examined the relationship between the achievement scores of the seventh grade courses and the subtest scores of the OKÖSYS and found that the variance values explained were at a sufficient level and supported the purpose of the OKÖSYS prepared according to the primary education curriculum.

In general, it is seen that 8th-grade academic achievement scores are highly positively correlated with OKMS subtest scores. Since the relationship between the two data sets gives the agreement of the subtest raw scores with the course achievement measures (Deniz, 2003), it can be stated that the concurrent validity of the OKMS scores in this study is at a sufficient level. Hattie and Gan (2011) emphasized that the feedback given to students during the teaching process about the level at which they can reach the achievements of the curriculum and whether they have the desired behavioral changes positively affects the learning process. Since students' school academic achievement scores are positively correlated with the OKMS subtest scores, it reveals that it is important to identify the subjects in which students are unsuccessful or deficient in the teaching process and to eliminate these deficiencies.

Limitations and Recommendations

Although this study explained the relationship between achievement scores and OKMS subtest raw scores, there is a need for further research to address the limitations. This research covers the academic data of 8th-grade students studying in 24 different secondary schools in Bursa province. The first limitation is that the study data was collected only from Bursa province. The second limitation is that only public secondary schools were included in the study. Future studies should be carried out covering different provinces of Turkey, and students in private secondary schools should also be included in the study. In addition, in order to explain the students' achievement in the OKMS, the end-of-year achievement scores for each course were considered in the study. Year-end

achievement scores include written scores, course participation scores, and project scores, if any. In future studies, only written scores can be included.

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