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A SCIENCE DIPLOMACY SCALE FOR HIGHER EDUCATION: A VALIDITY AND RELIABILITY STUDY IN TÜRKIYE

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Abstract

It is stated in the literature that scientific studies carried out by higher education institutions, which are among the leading institutions that produce knowledge and science, are effective in the development of science diplomacy practices. However, no research has been found in Türkiye on the level of this effect. In this context, there was gap in the literature develop a scale of science diplomacy in higher education in order to determine the extent to which scientific studies carried out by higher education institutions affect science diplomacy practices. The aim of the study was to develop a scale that can reveal the impact of scientific studies conducted by higher education institutions on science diplomacy practices according to the opinions of deans and vice deans. A total of 183 individuals participated in the exploratory factor analysis (EFA) study and 246 individuals participated in the confirmatory factor analysis (CFA) study using the simple random sampling method to create the study group for the research. EFA, CFA, and Cronbach alpha values were examined for validity and reliability analyses of the Science Diplomacy Scale in Higher Education. Four items were redundant items in the factor analysis, and they were removed from the scale based on expert opinion. The CFA results show that the goodness-of-fit indices of the model fall within the reference ranges stated in the literature and that the model fits well with the research data. The findings obtained, the scale is a valid and reliable measurement tool. As a result of the research, a four-dimensional and 25-item Science Diplomacy Scale in Higher Education was developed with 5-point Likert rating.

Keywords

Science Diplomacy, Scale Development, Higher Education, Dean, Türkiye.

Resumo

A literatura refere que os estudos científicos realizados por instituições de ensino superior, que se encontram entre as principais instituições produtoras de conhecimento e ciência, são eficazes no desenvolvimento de práticas de diplomacia científica. No entanto, não foi

encontrada nenhuma investigação na Turquia sobre o nível deste impacto. Neste contexto, havia uma lacuna na literatura no que diz respeito ao desenvolvimento de uma escala de diplomacia científica no ensino superior, a fim de determinar em que medida os estudos científicos realizados pelas instituições de ensino superior afetam as práticas de diplomacia científica. O objetivo do estudo foi desenvolver uma escala capaz de revelar o impacto dos estudos científicos realizados pelas instituições de ensino superior nas práticas de diplomacia científica, de acordo com as opiniões dos reitores e vice-reitores. Um total de 183 indivíduos participaram no estudo de análise fatorial exploratória (AFE) e 246 indivíduos participaram no estudo de análise fatorial confirmatória (AFC), utilizando o método de amostragem aleatória simples para criar o grupo de estudo para a investigação. Os valores da AFE, da AFC e do alfa de Cronbach foram examinados para efeitos de análise da validade e da fiabilidade da Escala de Diplomacia Científica no Ensino Superior. Quatro itens foram redundantes na análise fatorial e retirados da escala com base na opinião de peritos. Os resultados da AFC mostram que os índices de adequação do modelo estão dentro dos intervalos de referência indicados na literatura e que o modelo se ajusta bem aos dados da investigação. De acordo com as conclusões obtidas, a escala é um instrumento de medição válido e fiável. Como resultado da investigação, foi desenvolvida uma Escala de Diplomacia Científica no Ensino Superior, de quatro dimensões e 25 itens, com classificação de Likert de 5 pontos.

Palavras-chave

Diplomacia Científica, Desenvolvimento de Escala, Ensino Superior, Reitor, Turquia.

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Introduction

Diplomacy, a concept as ancient as the history of civilization, has numerous definitions in the literature. Diplomacy is an attempt to find solutions through mutual negotiation to issues that exist or may arise between states. In other words, diplomacy is the process of relations conducted by state actors, taking into account the goals they set for themselves and the capabilities they possess, as well as the goals and capabilities of other states (Kerr & Wiseman, 2013, p. 164; Knight, 2022, p. 9).

Power is the combination of military, economic, political, and social resources possessed by states. The elements of national power consist of factors such as geographical location, natural resources, industrial capacity, economic development, military superiority, and population. The instruments states use in their relations with other states, such as coercion, deterrence, and creating pressure, are described as hard power; while instruments such as influence, attraction, and encouragement are described as soft power. Soft power allows desired outcomes to be achieved not through material incentives and payments, but through a state's culture, norms, values, and attractive international policies (Açıkalın & Sarı, 2021, p. 1693; Galluccio, 2021, p. 35; Wilson III, 2008, p. 111).

Nye noted that states can use soft power as a tool to garner public support. The concepts of soft power and public diplomacy are complementary elements in obtaining public support. Public diplomacy is a diplomatic method that translates soft power resources and practices into policy. In other words, public diplomacy is the process by which states and non-state actors establish positive relations with other societies. Public diplomacy facilitates the recognition of values, traditions, social structures, and beliefs, and supports the identification of common interests with other societies (Cull, 2009, p. 15; Hayden, 2011, p. 27; Nye, 1990, p. 15; Pavon Guinea & Codina, 2023, p. 8).

Among the new types of public diplomacy seen in the present era, science diplomacy is used to achieve international development through scientific collaborations. Although science diplomacy is among the new types of diplomacy in this era, it is not a new phenomenon when viewed historically. Great powers have invited renowned scientists of the time to their countries to increase scientific research and gain respect for their countries. However, innovations in diplomacy and science have elevated the concept of science diplomacy to a more significant position in the 21st century (Moedas, 2016, p. 2; Turekian et al., 2015, p. 4; Pinto, 2022, p. 100).

Science Diplomacy

Science diplomacy is defined as the realization of foreign policy goals through science, facilitating and enhancing international scientific cooperation. Science diplomacy serves the function of building scientific bridges between states and societies. The instruments of science diplomacy can be listed as:

- Inter-governmental scientific cooperation initiatives,
- Establishing partnerships for scientific endeavors that exceed individual country budgets and require large investments,
- Collaboration between governments, civil society organizations, and scientists on global issues such as health, environment, climate, security, mass migrations, and education,
- Dissemination of scientific research and publications,
- Deployment of scientists abroad,
- Scholarship opportunities for international students or researchers (Galluccio, 2021, p. 26; Flink & Rüffin, 2019, p. 106; Kıran & Açıkalın, 2021, p. 978; Ruffuni, 2017, p. 13; Turekian, 2018, p. 5; The Royal Society, 2010, p. 15).

Although science diplomacy is mostly considered as positive way of dialogue between actors, there are also some criticisms may arise from the intersection of politics and science. In this context, difficulties of implementing science diplomacy are mainly discussed in the literature, highlighting several criticisms, including:

- Increasing competition and pressure between countries in the field of science and technology,
- The perception of science as a tool for political action on the international stage,
- The possibility that political pressure might overshadow scientific autonomy,
- The potential for scientific research, knowledge production, and sharing to be hindered or lose inclusivity in conflict-ridden environments,
- Scientists becoming dependent on project-based funding initiatives that serve foreign policy objectives (Flink & Rüffin, 2019, pp. 16-17; Weis, 2005, p. 310).

Unless this harmony is achieved, science diplomacy will face the risk of becoming dysfunctional. Therefore, in order to have effective and positive science diplomacy practices to be carried out through objective, transparent, critical, functional and inclusive strategies should be developed between policy makers and the scientific community (Flink, 2022, p. 197; Ruffini, 2020, p. 7).

Higher Education

Higher education institutions play a significant role in the development of international networks within individual, knowledge, and communication flows, in the establishment of new partnerships with the industry, especially in the cultural and scientific fields, and in completing the diplomatic networks of states. Higher education institutions contribute to the establishment of mutually beneficial relationships between close and distant geographical regions through international projects in collaboration with NGOs, accelerating global change with developments in communication and technology. Higher education institutions also activate public diplomacy in solving global issues and economic development (Erçetin, 2001, p. 77; Kitamura, 2015, p. 27; Moghimi et al, 2016, p. 200; Moshtari & Safarpour, 2024, p. 90; Vinet, 2010, p. 6773).

When examining the literature, the internationalization process of higher education institutions has been addressed within the framework of cultural diplomacy, which is considered a tool of public diplomacy. Student and staff mobility, language learning, internship programs, and efforts to attract foreign students to the country were examined from a cultural perspective. Additionally, many activities such as creating brand awareness in higher education, implementing success rankings and competitiveness practices, collaborations with NGOs, local governments, and industries, public relations efforts, and active use of media and digital channels were evaluated from the perspective of cultural diplomacy (Gienow-Hecht & Donfried, 2010, p. 5; Férnandez, 2021, p. 32). However, research projects based on international cooperation between higher education institutions, science and technology centers, international education centers, binational universities, and multinational expert networks have given diplomacy a scientific dimension beyond cultural studies, ensuring the production, dissemination, and utilization of knowledge. With the changing internationalization process dependent on knowledge, innovation, economy, and technology development, the concept of science diplomacy has gained importance in higher education. Especially in the 21st century, international collaborative scientific studies by higher education institutions play an important role in addressing global issues such as increasing global-scale migrations, epidemic diseases, security, economic deprivation, environmental and climate change, and natural disasters, and in generating global solutions (Adam, 2024, p. 510; Knight, 2014, p. 2; Sutton & Lyons, 2013, p. 6; Zakerian et al., 2017, p. 187).

Science Diplomacy Practices in Higher Education

The question about mission of higher education institutions is not easy task (Hashim, 2022). Although there various and newly discussed definitions it can be said that higher education aim to educate and prepare the individuals of the future for their professions, as well as to generate new scientific knowledge and present this knowledge for the benefit

of societies (White, 1997; Barnett, 1998; Erçetin, 2001). From this standpoint, higher education institutions can play an active role in increasing and developing science diplomacy practices. Higher education institutions contribute to complementing the diplomatic network of states, especially in the cultural and scientific fields, by developing international networks within individual, knowledge, and communication flows, and establishing new partnerships with industry (Kaliguna, 2020). They can also contribute to create mutually beneficial relationships between close and distant geographical areas through international projects in collaboration with NGOs, accelerating global change with developments in communication and technology. Higher education institutions activate science diplomacy in solving global issues and promoting economic development. Therefore, in an international politics that transcends national borders and sometimes leads to the formation of destructive regional blocs, significantly reshaping the world and bringing about both competition and collaboration, the presence of higher education institutions is profoundly felt (Moghimi et al., 2016, p. 201; Sandström & Hudson, 2018; Vinet, 2010, p. 6773).

Science diplomacy practices conducted in higher education institutions can be listed as:

- International scientific publications, research, and reports by faculty members, especially in the context of solving global-scale issues,
- Participation of faculty members as experts in making and implementing foreign policy targets,
- Internationally collaborative symposia, workshops, and seminars organized in higher education,
- The assignment of faculty members abroad for research and teaching,
- Programs and scientific projects aimed at attracting qualified students from foreign countries,
- Scholarship opportunities for international students,
- International scientific collaboration projects conducted in partnership with various industrial sectors,
- Contributing to international mission, promotion, and branding efforts (Asadi et al., 2021, p. 41; Borchelt, 2008, p. 150; Knight, 2012, pp. 21-22; Kitamura, 2015, p. 29; Moghimi et al., 2016, p. 202; Olgun & Erçetin, 2024, p. 1124; Sutton & Lyons, 2013, p. 8; Tian & Liu, 2021, p. 199; Zakerian et al., 2017, p. 189).

Along with the discussion role of higher education institutions in science diplomacy, there is limited literature on how it can be measured and it can be said that there is gap for instruments and case studies related for it. In this context, the aim of the study is to develop a scale that can reveal the impact of scientific studies conducted by higher education institutions on science diplomacy practices according to the opinions of deans and vice deans in Türkiye.

Research Methodology

This section outlines the stages of development process for the Science Diplomacy Scale (SDS) in Higher Education.

Study Group

The population of the study consisted of 531 deans and vice deans serving at universities in Ankara during the academic year 2023-2024. There are various opinions in the literature regarding the sample size for the scale development process. Hatcher (1994) suggested that the sample size should be at least 5 times the number of items in the scale or over 150 (Hatcher, 1994, p. 9). With the simple random sampling method, each participant has an equal chance of being selected (Potas & Ok Akçil, 2020, p. 145). In the study conducted based on the principle of voluntarism using the simple random sampling method, 183 individuals participated in the exploratory factor analysis, and 246 individuals participated in the confirmatory factor analysis, comprising the study group for the research.

Data Analysis

An extensive literature review was conducted during the process of developing the Science Diplomacy Scale (SDS) in Higher Education. Articles, theses, domestic and foreign books, and research reports in indexes such as Google Scholar, Tr Index, Scopus, and Web of Science were examined. Keywords such as science diplomacy, public diplomacy, and soft power were used for electronic sources. A pool of 33 items was created, believed to reflect the level of impact of scientific studies conducted by higher education institutions on science diplomacy. Five experts were consulted during preparation of the scale. Each item was reviewed as "appropriate," "inappropriate," or "modifiable." After expert review, items with consensus or divergence of opinion were identified individually. Four items in the pool were revised and adjusted based on expert opinions, resulting in a reduction to 29 items. Following the expert evaluations, a scale was prepared using a five-point Likert scale ranging from "very highly effective (5), highly effective (4), moderately effective (3), slightly effective (2), and ineffective (1)" options, in line with the purpose of the research.

Research Ethics

In order to collect data for the study, approval was obtained from Ankara Hacı Bayram Veli University Ethics Committee on 27/12/2023 with meeting decision number 2023/369.

Findings

This section includes the validity and reliability analyses of the SDS. Factor analysis was conducted to determine the structural validity of the SDS. Factor analysis is one of the methods used to obtain evidence for construct validity in scale development or adaptation studies. Rather than providing a single coefficient of validity for the measurement purpose, factor analysis is applied to reveal the factor structure or confirm a previously hypothesized factor structure (Hair et al., 1998). Both exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) can be used for factor analysis. EFA allows us to see the possible theoretical structure of the variables, while CFA provides experimental

evidence to support the theoretical structure. In this study, principal component analysis (varimax rotation) was used for exploratory factor analysis to test the structural validity of the scale. SPSS 22.00 and AMOS 27.00 software programs were used for the validity and reliability analyses in both EFA and CFA.

Exploratory Factor Analysis (EFA)

Exploratory factor analysis was conducted to test the structural validity of the Science Diplomacy Scale in Higher Education. In this analysis, items that do not measure the same construct were removed, and the common factor variance, factor eigenvalues, explained total variance ratio, and item factor loadings were examined. In this context, attention was paid to common variance of items >.10, factor loading value of 1, explained total variance ratio of >50%, and item factor loadings >.40, as well as a difference of .10 between items loaded on multiple factors.

In order to test the suitability of the data for factor analysis, it is necessary to examine the Kaiser-Meyer-Olkin (KMO) and Bartlett test analysis values. The KMO value is expected be >.50, and the Bartlett value should be significant (Field, 2000, p. 424).

Table 1. KMO and Bartlett Test Analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.930
Bartlett's Test of Sphericity	**Approx. Chi-Square**	4419.392
	df	406
	Sig.	.000

In the study, according to Table 1, the KMO value of the scale was greater than .50 (KMO=.930), and the Bartlett test result was significant (X2=4419.392; p=.000). After examining these values, the data were found to be suitable for factor analysis.

In Table 2, the communalities table is based on principal component analysis. After reviewing this table, the values for the items ranged between .47 and .83. Since the item factor loadings of the scale are greater than .40, no item was removed at this point, and factor analysis continued.

In Table 3, five factors emerged with eigenvalues greater than 1, explaining a total variance of 69.5%. Varimax rotation was applied to the component matrix to test the scale's five-factor structure, and the results are presented in Table 4.

When there is a difference of less than .10 between the factor loading values of an item across multiple factors, a collinearity issue arises. Since each item should measure only one attribute in exploratory factor analysis, collinear items need to be removed from the scale to ensure its construct validity. In this context, items 27, 23, and 19 in Table 4 were collinear. These collinear items were sequentially removed during the analysis. Initially, item 27 was removed, and the analysis was repeated. Upon removing item 27 from the scale, items 10, 21, and 23 were collinear. Consequently, item 23 was first removed, followed by item 21, and finally item 10, to refine the scale. With expert consultation, a total of four items were removed from the scale. As a result, the analysis was repeated for the scale consisting of 25 items after removing the four items.

The KMO value of the scale was greater than .50 (KMO=,923), and the Bartlett test result was significant (X2=3524.656; p=.000).

After examining Table 5, which shows the total explained variance after the removal of collinear items, there were four factors with eigenvalues exceeding 1. These four factors explain a total variance of 66.5%. According to the analysis, the scale has a four-dimensional structure. In the first factor, there are a total of 10 items explaining 51% of the variance; in the second factor, there are 5 items explaining 6.8% of the variance; in the third factor, there are 5 items explaining 4.7% of the variance; and in the fourth factor, there are 5 items explaining 4.4% of the variance. In the process of scale development, it is necessary for the explained variance of the scale to exceed 2/3 of the total variance; in other words, to be greater than 66%. The data obtained from the factor analysis meet this criterion.

Table 2. Communalities of the Science Diplomacy Scale (SDS) in Higher Education (YBDO)

Items	Initial	Extraction
s1	1.000	.575
s2	1.000	.667
s3	1.000	.752
s4	1.000	.665
s5	1.000	.796
s6	1.000	.724
s7	1.000	.515
s8	1.000	.734
s9	1.000	.619
s10	1.000	.633
s11	1.000	.501
s12	1.000	.779
s13	1.000	.816
s14	1.000	.825
s15	1.000	.692
s16	1.000	.754
s17	1.000	.672
s18	1.000	.610
s19	1.000	.750
s20	1.000	.628
s21	1.000	.479
s22	1.000	.769
s23	1.000	.833
s24	1.000	.810
s25	1.000	.694
s26	1.000	.646
s27	1.000	.807
s28	1.000	.761
s29	1.000	.675

Table 3. Explained Total Variance of the Science Diplomacy Scale (SDS) in Higher Education (YBDO)

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	15.032	51.834	51.834	15.032	51.834	51.834	4.995	17.223	17.223
2	1.731	5.969	57.803	1.731	5.969	57.803	4.608	15.890	33.113
3	1.189	4.099	61.901	1.189	4.099	61.901	4.341	14.970	48.083
4	1.135	3.915	65.816	1.135	3.915	65.816	3.580	12.344	60.426
5	1.094	3.771	69.587	1.094	3.771	69.587	2.657	9.161	69.587
6	.924	3.187	72.774						
7	.865	2.982	75.756						
8	.727	2.507	78.264						
9	.688	2.373	80.636						
10	.586	2.021	82.658						
11	.535	1.846	84.504						
12	.480	1.656	86.160						
13	.428	1.476	87.636						
14	.413	1.423	89.058						
15	.384	1.325	90.383						
16	.356	1.229	91.612						
17	.329	1.135	92.747						
18	.294	1.014	93.761						
19	.271	.934	94.695						
20	.233	.804	95.499						
21	.203	.700	96.199						
22	.201	.692	96.892						
23	.179	.616	97.508						
24	.168	.579	98.087						
25	.142	.489	98.576						
26	.122	.421	98.998						
27	.114	.394	99.392						
28	.092	.319	99.710						
29	.084	.290	100.000						

Table 4. Rotated Component Matrix Resulting from Factor Analyses

Item No	Component 1	2	3	4	5
s5	.767	.338	.111		.282
s12	.755	.135		.214	.370
s13	.632		.614	.175	
s22	.628	.403	.230	.360	.171
s8	.583	.461	.311		.286
s10	.545	.385	.347	.161	.204
s28	.263	.776	.201		.208
s24	.342	.676	.374	.300	
s1	.299	.577	.125	.352	.116
s29	.503	.558	.108	.226	.219
s27		**.547**	**. 545**	.172	.421
s19	.459	**.521**	**.412**	**.207**	**.235**
s20	.209	.505	.331	.431	.181
s23	.472	**.502**	**.469**	**.328**	**.176**
s15	.252	.147	.706	.254	.208
s16	.127	.316	.687	.307	.268
s14	.546	.213	.664	.164	.119
s2		.355	.606	.399	.123
s17	.452	.394	.519	.204	
s18	.125	.170	.220	.669	.263

s7		.160	.141	.664	.170
s9	.368	.158	.251	.623	
s25	.428	.377		.599	
s4		-.153	.415	.567	.377
s21	.360	.205	.228	.430	.265
s3	.290	.114	.210	.209	.753
s6	.342	.305	.329	.175	.613
s11	.180	.335		.318	.505
s26	.339	.457	.323		.465

Table 5. Total Explained Variance after Removal of Collinear Items

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.677	50.708	50.708	12.677	50.708	50.708	5.595	22.380	22.380
2	1.686	6.744	57.452	1.686	6.744	57.452	4.281	17.122	39.502
3	1.166	4.665	62.117	1.166	4.665	62.117	3.383	13.533	53.035
4	1.112	4.448	66.565	1.112	4.448	66.565	3.383	13.530	66.565
5	.980	3.921	70.486						
6	.846	3.382	73.869						
7	.807	3.228	77.097						
8	.683	2.731	79.828						
9	.598	2.391	82.219						
10	.563	2.251	84.470						
11	.430	1.721	86.191						
12	.416	1.665	87.856						
13	.395	1.582	89.437						
14	.359	1.434	90.871						
15	.350	1.400	92.271						
16	.314	1.254	93.525						
17	.276	1.105	94.631						
18	.254	1.014	95.645						
19	.227	.908	96.553						
20	.195	.782	97.335						
21	.174	.697	98.032						
22	.148	.594	98.626						
23	.129	.518	99.144						
24	.121	.484	99.628						
25	.093	.372	100.000						

The results of the scree plot showing four factors with eigenvalues above 1 are presented in Figure 1.

Figure 1. Scree Plot After Removal of Cross-Loadings

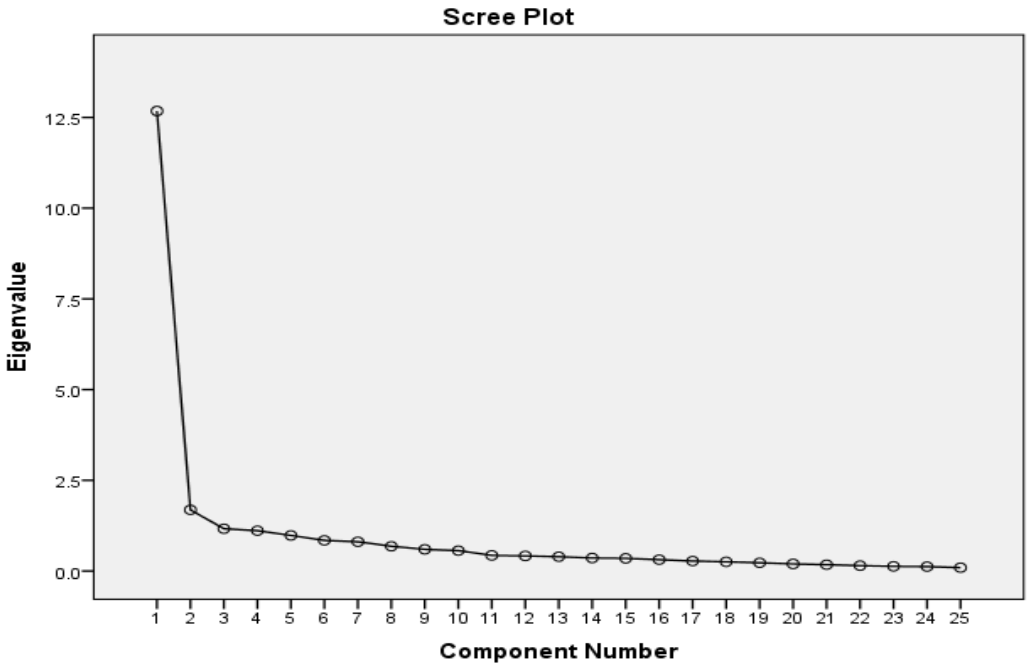


Table 6. Rotated Component Matrix Resulting from Factor Analysis after Removal of Cross-Loadings

	Component			
	1	**2**	**3**	**4**
s28	.743	.208	.223	.122
s24	.714	.395	.144	.312
s29	.709	.199	.352	.158
s22	.634	.355	.362	.247
s1	.632	.171	.184	.318
s25	.625	.175	.109	.455
s5	.602	.307	.532	
s8	.590	.426	.451	
s19	.589	.468	.350	.223
s20	.527	.322	.166	.448
s14	.372	.771	.267	.144
s13	.337	.762	.232	.101
s15	.165	.707	.230	.342
s16	.244	.630	.225	.447
s17	.501	.596	.165	.183
s3	.112	.199	.784	.301
s6	.293	.324	.677	.280
s12	.447	.267	.615	
s26	.445	.331	.518	.128
s11	.334		.490	.347
s18	.235	.152	.226	.704
s7	.171		.128	.699

s4	-.101	.354	.300	.625
s2	.252	.520		.526
s9	.383	.289		.521

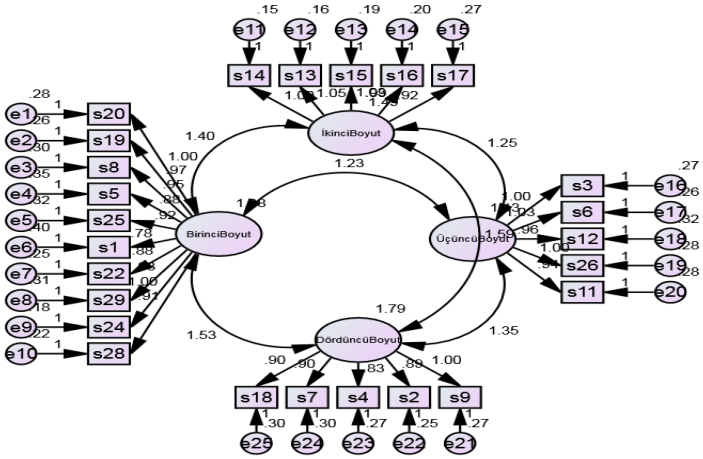
The four underlying factors resulting from exploratory factor analysis were named as dimensions based on the content of the items constituting the factors and their factor loading values. In this context, the first dimension was named "collaboration and scientific work" (10 items), the second dimension was "partnership and societal contribution" (5 items), the third dimension was "education and teaching" (5 items), and the fourth dimension was "institutional internationalization" (5 items).

To confirm whether the factor structure emerging from the exploratory factor analysis of the Science Diplomacy Scale in Higher Education will be validated, confirmatory factor analysis was conducted.

Confirmatory Factor Analysis (CFA)

Confirmatory factor analysis was used to determine the construct validity of the scale. The most commonly used goodness-of-fit indices in CFA, which are also used as references in this study, are listed as follows: chi-square test statistic (χ^2), degrees of freedom (df), chi-square/degrees of freedom ratio (χ^2/df), normed fit index (NFI), and comparative fit index (CFI). A sample of 246 participants was used for confirmatory factor analysis of the scale. In this study, the goodness-of-fit indices for the four-dimensional scale structure were calculated. The absolute fit indices of the scale included CMIN/DF=3.38; RMSEA=0.099; incremental fit indices included NFI=0.911; and parsimony fit indices included CFI=0.935; RFI=90; IFI=0.935; and TLI=0.928. The model obtained from the confirmatory factor analysis shows that the goodness-of-fit indicators fall within the reference ranges stated in the literature, indicating a good fit with the research data. The standardized path diagram obtained from CFA is presented in Figure 2.

Figure 2. Path Diagram for the Science Diplomacy Scale in Higher Education (YBDO)



Reliability Analysis

In order to determine whether the scale is a reliable measure, Cronbach's alpha reliability coefficient was calculated. The results are presented in Table 7.

Table 7. Cronbach's Alpha Values for the Scale and Dimensions

Dimensions	Cronbach's Alpha Reliability Coefficient
Collaboration and Scientific Work	.97
Partnership and Social Contribution	.97
Education and Teaching	.95
Institutional Internationalization	.96
Total	.99

According to Table 7, the Cronbach's alpha reliability coefficients for the Science Diplomacy Scale in Higher Education were calculated as follows: 0.97 for collaboration and scientific work dimension, 0.97 for partnership and social contribution dimension, 0.95 for education and teaching dimension, 0.96 for institutional internationalization dimension, and 0.99 for the total scale. This result indicates that the data obtained from the scale are reliable.

Conclusion

Higher education is one of the key actors that contribute to diplomatic relations with state, non-state actors, and civil society organizations by producing knowledge and science. Many international activities such as research, projects, scientific publications developed to solve global problems around the world, cooperation with the sector and NGOs, provision of scientific data for foreign policy targets, scientific studies of students and faculty members within the scope of international exchange programs, financial and technological support provided for conducting research in developing countries are carried out more efficient in higher education institutions.

In this context, it is believed that the scientific studies conducted by higher education, which are among the leading centers of science production, have an impact on the practices of science diplomacy. However, current literature has gap addressing measure tool on role of higher education institutions . In this respect, scale of science diplomacy in higher education in order to determine the level to which scientific studies conducted by higher education institutions affect science diplomacy practices.

The aim of the study was to develop a scale that can reveal the impact of scientific research conducted by higher education institutions on science diplomacy practices, based on the opinions of deans and vice deans. The study is limited to the views of deans and vice deans serving at universities in Ankara. The evaluations made within the scope of the research are limited to the time period in which the scale was implemented, the data obtained from the scale form, and the results of the data.

The validity and reliability analyses for the Science Diplomacy Scale in Higher Education were examined. The KMO value of the scale was greater than .50, and the Bartlett test result was significant. As a result of EFA, the scale has a four-factor structure with eigenvalues greater than 1, explaining 66.5% of the total variance. According to EFA

data, four items in the scale were overlapping items, and these overlapping items were sequentially removed during the analysis. Four items were removed from the scale based on expert opinions, and the analyses were repeated for the 25-item scale. The CFA results show that the goodness-of-fit indices of the model fall within the reference ranges stated in the literature and that the model fits well with the research data. In the study, Cronbach's alpha reliability coefficient was calculated to determine whether the scale is reliable, and the scale had a high level of reliability.

In conclusion, the scale consists of four dimensions and 25 items. In this context, there are 10 items in the dimension of cooperation and scientific research, 5 items in the dimension of partnership and societal contribution, 5 items in the dimension of education and teaching, and 5 items in the dimension of institutional internationalization. The items in the scale are rated on a 5-point Likert scale ranging from ineffective (1), low level of effectiveness (2), moderate level of effectiveness (3), high level of effectiveness (4), to very high level of effectiveness (5). The highest possible score that can be obtained from the scale is 125, and the lowest score is 25.

Consequently, Developed scale will contribute to the literature and to the determination of the current situation in higher education institutions within the framework of science diplomacy practices. The study was limited to the opinions of deans and assistant deans working in Türkiye. To contribute to the validity and reliability of the scale, it can be applied to groups with different sizes and characteristics such as rectors vice rectors, and institute directors, and academic staff such as faculty members and research assistants. In addition, through the mentioned scale, science diplomacy practices of higher education institutions in Türkiye and foreign countries can be analyzed comparatively.

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Attachment: Science Diplomacy Scale in Higher Education (SDS)

Item No.	**Cooperation and Scientific Work**
S28	Presentation of scientific information and suggestions by faculty members at your faculty for the resolution of international issues
S24	International promotional activities of your faculty
S29	Adaptation ability of faculty members at your faculty to the European Higher Education Area
S22	International mission of your faculty
S1	Scientific studies such as international symposiums, workshops, seminars organized at your faculty
S25	International diploma equivalence provided by your faculty
S5	International publications authored by faculty members at your faculty
S8	International scientific projects conducted by faculty members at your faculty
S19	Scientific collaboration studies conducted between your faculty and international higher education institutions
S20	Scientific collaboration studies conducted between your faculty and international non-governmental organizations
Item No	**Partnership and Societal Contribution**
S14	Participation status of your faculty in international R&D funds
S13	Budget used by your faculty in international scientific studies
S15	Participation status of students at your faculty in techno-parks or socio-parks projects
S16	International scientific collaboration projects conducted by your faculty with the business world (sector)
S17	International alumni network (communication network) of your faculty
Item No	**Education and Teaching**
S3	Student exchange programs implemented at your faculty
S6	Faculty exchange programs implemented at your faculty
S12	Use of foreign language by faculty members at your faculty in producing scientific knowledge
S26	Assignment of faculty members at your faculty as consultants in various institutions as part of scientific studies
S11	Visibility of faculty members at your faculty in the media
Item No	**Institutional Internationalization (5 item)**
S18	Programs conducted in foreign languages at your faculty
S7	Foreign national faculty members working at your faculty
S4	Scholarship opportunities provided to international foreign national students at your faculty
S2	Activities such as international competitions, Olympiads, festivals organized at your faculty
S9	Internationally accredited programs at your faculty