İnsan ve Toplum Bilimleri Araştırmaları Dergisi
Journal of the Human and Social Science Researches
[2147-1185]
13 th Years

2024, 13 (2), 697-716 | Research Article

The Impact of Undergraduate Students' Thinking Styles on Problem-Solving Skills

Cumhur GÜNGÖR [1] **Emine AKKAŞ BAYSAL** [2]

Abstract

The aim of this study is to examine the thinking styles of university students are and the effect of thinking styles on their problem-solving skills. The research used the correlational survey model because the relationship between the "thinking styles" and "problem solving skills" were examined. The sample of the research consisted of 566 undergraduate students. Personal information form, Thinking Styles Scale and Problem-Solving Inventory are used for data collection. Descriptive statistics such as mean and standard deviation, t-test, Anova and Pearson correlation, regression analysis have been utilized in data analysis. The level of students' thinking styles and problem-solving skills has been observed to be at a moderate level. There is a significant difference between students' thinking styles and problem-solving skills in terms of gender. The students' thinking styles and problem-solving skills do not show a significant difference in terms of class level. There is no significant difference in the relationship between students' thinking styles and problem-solving skills in terms of age variable. There exists a significant correlation between students' thinking styles and their problem-solving abilities. Students' thinking styles have a significant effect on their problem-solving skills. This study makes an important contribution to understand the thinking styles and problem-solving skills of university students and to examine the relationships in these fields. The results show that educators and guidance professionals should support students' problem-solving skills by taking into account their thinking styles.

Keywords: Problem-Solving, Thinking Style, Learning, Reasoning Ability, Creative Thinking.

Güngör, C., & Akkaş Baysal, E. (2024). The Impact of Undergraduate Students' Thinking Styles on Problem-Solving Skills. *Journal of the Human and Social Science Researches*, 13(2), 697-716. https://doi.org/10.15869/itobiad.1299119

Date of Submission	18.05.2023
Date of Acceptance	30.05.2024
Date of Publication	30.06.2024

[1] Assoc. Prof. Dr, Afyon Kocatepe University, Sandıklı School of Applied Sciences, Afyonkarahisar, Türkiye, cgungor@aku.edu.tr, ORCID: 0000-0001-9117-3713

[2] Asst. Prof. Dr, Afyon Kocatepe University, Sandıklı School of Applied Sciences, Afyonkarahisar, Türkiye, akkasemine85@hotmail.com, ORCID: 0000-0002-5711-0847

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2024, 13 (2), 697-716 | Araştırma Makalesi

Üniversite Öğrencilerinin Düşünme Sitillerinin Problem Çözme Becerileri Üzerindeki Etkisi

Cumhur GÜNGÖR [1] **Emine AKKAŞ BAYSAL** [2]

Öz

Bu çalışmanın amacı, üniversite öğrencilerinin düşünme tarzlarını incelemek ve düşünme tarzlarının problem çözme becerileri üzerindeki etkisini değerlendirmektir. Araştırma, "düşünme tarzları" ile "problem çözme becerileri" arasındaki ilişkiyi incelemek için ilişkisel tarama modelini kullanmıştır. Araştırmanın örneklemini 566 lisans öğrencisi oluşturmaktadır. Veri toplama için Kişisel Bilgi Formu, Düşünme Tarzları Ölçeği ve Problem Çözme Envanteri kullanılmıştır. Veri analizinde ortalama, standart sapma, t-testi, Anova ve Pearson korelasyonu, regresyon analizi gibi tanımlayıcı istatistikler kullanılmıştır. Öğrencilerin düşünme tarzları ve problem çözme becerileri düzeyinin orta düzeyde olduğu gözlemlenmiştir. Cinsiyet açısından öğrencilerin düşünme tarzları ve problem çözme becerileri arasında anlamlı farklılık bulunmaktadır. Sınıf düzeyi açısından öğrencilerin düşünme tarzları ve problem çözme becerileri arasında anlamlı bir fark bulunmamaktadır. Yaş değişkeni ile öğrencilerin düşünme tarzları ve problem çözme becerileri arasında anlamlı bir ilişki bulunmamaktadır. Öğrencilerin bilişsel tarzları ile problem çözme yetenekleri arasında anlamlı bir ilişki bulunmaktadır. Öğrencilerin düşünme tarzları, problem çözme becerileri üzerinde anlamlı bir etkiye sahiptir. Bu çalışma, üniversite öğrencilerinin düşünme tarzlarını ve problem çözme becerilerini anlamak ve bu alanlardaki ilişkileri incelemek açısından önemli bir katkı sağlamaktadır. Sonuçlar, eğitimcilerin ve rehberlik uzmanlarının öğrencilerin düşünme tarzlarını dikkate alarak problem çözme becerilerini desteklemeleri gerektiğini göstermektedir.

Anahtar Kelimeler: Problem Çözme, Düşünme Stili, Öğrenme, Akıl Yürütme Yeteneği, Yaratıcı Düşünme.

Güngör, C., & Akkaş Baysal, E. (2024). Üniversite Öğrencilerinin Düşünme Sitillerinin Problem Çözme Becerileri Üzerindeki Etkisi, *İnsan ve Toplum Bilimleri Araştırmaları Dergisi,* 13(2), 697-716. https://doi.org/10.15869/itobiad.1299119

Geliş Tarihi	18.05.2023
Kabul Tarihi	30.05.2024
Yayın Tarihi	30.06.2024

[1] Doç. Dr., Afyon Kocatepe Üniversitesi, Sandıklı Uygulamalı Bilimler Yüksekokulu, Afyonkarahisar, Türkiye, cgungor@aku.edu.tr, ORCID: 0000-0001-9117-3713

[2] Dr. Öğr. Üyesi, Afyon Kocatepe Üniversitesi, Sandıklı Uygulamalı Bilimler Yüksekokulu, Afyonkarahisar, Türkiye, akkasemine85@hotmail.com, ORCID: 0000-0002-5711-0847

Introduction

Thinking is the process of using one's mind to come to a conclusion by examining and comparing information and concepts to produce different ideas. It is one of the important skills that provide an individual with language, mental, and social development, and guides their learning and future. Thinking, which is an independent and unique action of the mind, is the ability to comprehend connections and forms, make comparisons, and the ability to separate and combine. Thinking is an active, purposeful, organized mental process carried out to understand the situation at hand (Demirel, 2005). Humans are thinking beings, and their ability to think distinguishes them from other living creatures. How humans think has been a subject of curiosity from the past to the present, and various studies have been conducted on thinking. Thinking is the disciplined way of conceptualizing, applying, analyzing, and evaluating knowledge obtained through observation, experience, intuition, reasoning, and other channels (Özden, 1997). The thinking process can be defined as turning objects and events in the external world into symbols and shapes. The brain performs many operations such as extracting meaning, hypothesizing, calculating, and producing symbols that will occur later on. These symbols are then transformed back into objects and events. The act of thinking is to guide one to achieve a goal, answer a question, or solve a problem, by transferring the organization of knowledge into a new and different form (Çubukçu, 2004).

Style is defined as the preference for the way an individual uses their skills (Sternberg, 1997) and processes information. It is thought of more as a preference than an ability. Therefore, different styles are not good or bad, just different (Duru, 2004). Everyone has a style profile. Individuals can change their styles to fit different tasks and situations. Even though individuals may prefer certain styles, those styles are not fixed but variable (Sternberg, 1997). Thinking style is defined as the different ways in which an individual's thinking processes and what goes on in their mind are manifested. It is a preference for individuals to use their abilities. That is, individuals prefer the forms that they can express themselves and control in any situation they encounter. Thinking styles are closely related to individuals' individual and socio-economic situations. They are the approaches and tendencies of individuals to exhibit in response to various problems, events, facts, and variables as a result of mental processes. Additionally, thinking styles are closely related to how individuals obtain and process information (Sünbül, 2004).

Identifying and developing thinking styles that are effective in creative thinking, decision making, problem solving, and reasoning is crucial for the development of an individual's thinking structure. Research suggests that individuals with a propensity for creative thinking tend to exhibit higher levels of creativity (Runco & Acar, 2012). Creative thinking involves generating multiple solutions to a problem, fostering originality and fluency in ideation. individuals who employ a balanced decision-making style, integrating both analytical and intuitive approaches, often make more effective decisions (Hammond et al., 1999). This balanced style allows for thorough analysis while also considering gut feelings and emotional cues. Effective problem solvers often exhibit a strategic thinking style, characterized by systematic planning, goal setting, and adaptability (Sternberg, 2003). This approach involves breaking down

complex problems into manageable components and employing structured strategies for solution.

In recent years, there has been an increase in studies on thinking styles. Despite the abundance of research, models, and theories abroad on what thinking styles are and why they are important in the educational process (Kirton, 2003; Kozhevnikov, 2007; Messick, 1976; Riding & Cheema, 1991; Sternberg, 1997; Sternberg & Zhang, 2001; Zhang & Sternberg, 2005), there are not enough studies or developed conceptual works in Turkey. Therefore, the purpose of this study is to provide a general framework of research, concepts, and theories related to thinking styles for all stakeholders in education. To this end, the concept of thinking style is explained, studies related to the concept are summarized, research results are discussed in relation to theories, and some recommendations are made for future studies.

The concept of problem, which expresses problematic, undesirable, and complex situations, is frequently encountered in life. Problems can be short-term, long-term, complex or simple, and can be classified as economic, emotional, or physical. These types of problems can overlap and become large and complex problems. The problem-solving approach is a way of thinking that is directed towards a specialized problem-solving process that involves the formation of reactions and the selection of the most appropriate response from among possible responses. Moreover, it is a cognitive skill that helps us cope with new situations and generate appropriate responses. Individuals solve some problems through logical reasoning, while others through trial and error. Problem-solving can be defined as a rational, goal-directed, conscious, and effortful activity. Knowing how to solve problems is not enough for an individual to solve the problems they face. It is also important that individuals perceive the problems they encounter as their own responsibility. It helps individuals adapt to the environment they live in. While some problems have definite solutions, others do not. Solving such problems requires multidimensional thinking, interdisciplinary knowledge, and creativity.

When the literature is examined, problem-solving skills are of great importance in academic achievement, in addition to planning and organizing. Although problem and problem-solving expressions are initially perceived as mathematical concepts, many of us use these concepts unconsciously in our daily lives. The topics covered in problem-solving are also applicable to the decision-making process. Most of the problems in our lives are related to the decisions we make. It can be said that each stage of the decision-making process is also a stage of problem-solving. Each decision we make is effective in reducing, contributing to the solution, or increasing the problem on our problems. Some problems reveal weak or wrong decisions. In fact, many problems can be prevented from arising by making correct, timely, and strong decisions (Paul & Elder, 2013, 206). Being aware of the problem, identifying and limiting the problem, collecting data related to the problem, proposing possible solutions (hypothesis formation), testing the hypotheses, reaching a conclusion and evaluation are the stages of problem solving. Being aware of the problem is the first step in problem solving. It is the realization that there is a problem and feeling it. It is necessary to fully understand what the problem is. In the stage of identifying and limiting the problem, the problem is clearly defined, addressed in a general framework, and limited. This limitation is important for data collection and solution. Collecting data related to the problem involves examining all

types of data sources and collecting comprehensive information. The information obtained from the sources is systematically and comprehensively analyzed and written. In the hypothesis formation stage, the question "how can the problem be solved?" is answered. Hypotheses are tested to try to solve the problem. After testing the hypotheses, reaching a conclusion and evaluation is an assessment of the solution. It is appropriate to explain whether the problem was solved with the relevant solution and if not, the reasons for it. Because it is natural for hypotheses to be both accepted and rejected.

Individual differences in education, as underscored by Gardner's (1983) theory of multiple intelligences, and personal variances are paramount determinants that influence the problem-solving skills we deploy in daily life (Sternberg, 1997). Thinking styles, which can be rooted in Sternberg's triarchic theory of intelligence (1985), play a pivotal role in this learning-teaching-problem solving continuum. In essence, individuals may employ diverse thinking styles, from analytical to creative to practical, in navigating solutions to a challenge (Zhang & Sternberg, 2005). Such variance not only fosters a sense of curiosity but also cultivates creativity and critical thinking, pivotal traits in promoting a creative mindset and enhancing high-level reasoning abilities (Paul & Elder, 2013). Through these individual differences, society functions much like a jigsaw puzzle, where the uniqueness of each piece—each person—contributes to a richer and more efficient problem-solving community (Salomon & Perkins, 1989).

Thinking styles are cognitive dispositions that affect how individuals approach problems, process information, and make decisions. Thinking styles can directly affect an individual's problem-solving skills and strategies. Different thinking styles can encourage different problem-solving approaches. Thinking styles studies show that different thinking styles are associated with different problem-solving strategies (Sternberg, 1997). For example, analytical thinkers often analyze problems in detail, while creative thinkers may adopt more flexible and experimental approaches. However, it is difficult to determine which thinking style is "best" because it depends on the type of problem encountered and the specific circumstances. For example, analytical thinking may be more effective when solving a routine problem, while creative thinking may be advantageous when faced with an unknown or original problem. Consequently, it is important to understand how to effectively integrate different thinking styles for the development of problem-solving skills. Each individual has a unique thinking style and it is possible to adopt more effective problem-solving strategies by recognizing and developing this style.

The aim of societies is to raise individuals who can think, research, question and have high judgment. Compared to the past, today's changing living conditions have brought very different perspectives to the education system. Perspective on the past; was that only knowledge was gained and it would be accepted directly without being questioned or researched. However, nowadays, it is aimed at gaining talented individuals who assimilate the acquired knowledge, adapt it appropriately, have independent thinking skills, and can think at a high level for creativity and problem solving. For this purpose, factors such as the attitude, personality traits, physical and spiritual needs of the person should be determined. The information obtained helps to reveal the person's best thinking style. With the modern age, students who can provide easy access to information, who can not only access but also use, analyze and blend,

have critical thinking skills with the power to make evaluations, research, question, think creatively and independently are needed. For this reason, it is very important for the individual to use the appropriate thinking style in terms of providing mental tactics for both obtaining information and appropriate problem-solving strategies used in the problem-solving process. Individuals use their thinking styles and problem-solving strategies to acquire new knowledge and perform problem solving. Thinking styles are a way of mental preference against various facts, events and problems that individuals encounter. Thinking styles are a state of choice in the use of the skills that people have (Sternberg, 1997; Zhang & Sternberg, 2005).

The aim of the research

This study aims to examine what the thinking styles of university students are and the effect of thinking styles on their problem-solving skills.

For this purpose, answers to the following questions will be sought:

1- What are the levels of thinking styles and problem-solving skills of university students?

2- Do university students' thinking styles level and problem-solving skills level differ significantly according to gender, age and grade?

3- Is there a significant relationship between university students' thinking styles and their problem-solving skills?

4- Do university students' thinking styles significantly predict their problem-solving skills?

Methodology

Research model

The research used the correlational survey model because the relationship between the "thinking styles" and "problem solving skills" were examined. Relational screening models aim to determine the presence and level of the change between two or more variables and to specify the relationships between the variables. The relational screening model does not provide a natural cause and result relationship but offers an opportunity to predict the other in case of knowing the one (Ayık & Ataş-Akdemir, 2015; Karasar, 2006).

Research sample

The sample of the research consisted of 566 university students. The sample were determined by a simple random sampling method. Simple random sampling is a method of selecting a sample comprising of N several sampling units out of the population with N number of sampling units so that every sampling unit has an equal chance of being chosen (Singh, 1996). 407 (71.9%) of the participants are female and 159 (28.1%) are male. The largest age group is the 20-21 age range, which comprised 233 (41.2%) of participants. The Social Sciences departments has the highest number of participants, with 273 (48.2%) of all. 317 (56.0%) of participants preferred to live in a dormitory during their education process. 417 (73.3%) of mothers are housewives, while 144 (25.4%) of fathers are workers. 279 (49.3%) of mothers has completed primary

school, while 192 (33.9%) of fathers are primary school graduates. These variables provide important information about the gender, age, faculty, accommodation preferences during education, and family background (i.e., parents' education and profession) of the participants.

Data collection tools and procedure

In this study, first of all, Personal Information Form was used to learn the demographic variables of university students, Thinking Styles Scale was used to determine their thinking styles, and Problem-Solving Skills scale in the problem-solving inventory was used to determine their problem-solving skills.

Personal information form

In the personal information form, questions such as gender, age, department studied at the university, class level, place of residence until university, number of siblings, high school from which he graduated, place of residence in the education process, mother's education level, mother's profession, father's education level, father's occupation were asked in the personal information form.

Thinking styles scale

Sternberg-Wagner's (1992) Thinking Styles Scale was used in this study. The Thinking Styles Scale (Sternberg & Wagner, 1992) was developed in line with the predictions of the Mental Self-Management Theory. It is a 7-point Likert-type scale consisting of 13 subtests (a total of 104 items) each containing eight items. The scale was adapted into Turkish for the first time in Turkey by Buluş (2006) and the number of items was reduced to 65. In the study, it was observed that the item-test correlations of the scale ranged from .31 to .84, and the alpha values of the subtests ranged between .66 (anarchic) and .93 (monarchic). In the said study, the factor structure of the scale was examined using the principal components method and varimax rotation, and five main factors with eigenvalues of 3.1, 1.9, 1.4, 1.2 and 1.1 were found, explaining 68.3% of the total variance.

As a result, in this study, a total of 65 questions were asked in order to determine the thinking styles of university students. The answers to the questions were provided with a Likert-type scale (Not at all appropriate-Not very appropriate- Somewhat appropriate- Quite appropriate - Appropriate-Very appropriate - Completely appropriate). In this study, the reliability value of the legislative sub-dimension is .69; the execution sub-dimension is .81; judgment sub-dimension is .82; monarchical sub-dimension is .59; hierarchical sub-dimension is .79; oligarchic sub-dimension is .68; global sub-dimension is .66; local subsize is .70; internal sub-dimension is .65; external sub-dimension is .76; liberal sub-dimension is .77; conservative sub-dimension is calculated as .75. In addition, the total reliability value of the scale was calculated as .94. According to Cronbach (1951), this shows that the measurement tool is usable.

Problem solving inventory

Heppner and Petersen' (1982) Problem Solving Inventory form was used. With this inventory, it has been prepared to determine the skills of people to solve the problems they encounter in many aspects of their daily lives. There are 35 questions in this scale. The answers to the questions were provided with a Likert-type scale (Totally Agree -

Partly Agree-Somewhat Agree- Somewhat Disagree -Solely Disagree - Totally Disagree).

The Problem-Solving Inventory, developed by Heppner and Petersen (1982) and adapted into Turkish by Sahin, Sahin and Heppner (1993), was used to determine the problem-solving skills of university students. It is stated that the scale evaluates the individual's perception of problem-solving ability and attitude towards problem solving style, not actual problem-solving skills. Factor analysis was performed for the validity study of the scale. Since the factor loads of 3 items (items 9, 22 and 29) in the original scale, which consisted of 35 items in total, were low, they were excluded from the scale. Scoring was done on the remaining 32 items and the range was 32-192. Low scores in scoring indicate effectiveness in solving problems, and high scores indicate inability to find effective solutions to problems. For the reliability of the scale, it is stated that the test-retest reliability coefficients performed with three-week intervals are .77 and .81, and the Cronbach Alpha value for internal consistency is .88 (Heppner et al. 2004, 352; Sahin, Sahin, & Heppner, 1993; Taylan, 1990: 38-41). The Cronbach Alpha value calculated in this study was found to be .82. The original scale consists of three sub-dimensions: confidence in problem solving, approach-avoidance style, and personal control (Taylan, 1990). However, according to Taylan (1990), it is thought that the sub-dimensions of the scale do not function very well in Turkish culture, but they contribute significantly to the total problem-solving inventory score. Therefore, the total score was used in this study, not the sub-dimensions of the scale. The total Cronbach Alpha value of the scale was found to be .90.

Data analysis

In the analysis of data, first of all, the sums of scales were checked to determine whether the data showed a normal distribution. Additionally, the Skewness and Kurtosis values of the sub-dimensions were calculated. For Thinking Styles Scale total, the Skewness value was calculated as -.382 and the Kurtosis value as 1.447. The Skewness value for the total of the Problem-Solving Inventory was calculated as -1.07 and the Kurtosis value as 1.777. These values were found to be between +1.96 and -1.96. Corder and Foreman (2009) stated that the data between +1.96 and -1.96 showed a normal distribution. Additionally, Q-Q Plots, line charts and mode, median, and mean values were examined (Pallant, 2020). Accordingly, it was determined that the data showed normal distribution and parametric tests were used in the analysis. Descriptive statistics tests, t-test, one-way ANOVA test, Pearson correlation analysis, and regression analysis were applied in the analyses. Analyses were used at the .05 significance level.

Findings

The findings obtained in the research were presented below in line with the sub-problems.

Findings for the first research question

The first sub-problem of the research aims to determine the levels of thinking styles and problem-solving skills of university students. The findings obtained in this direction are presented in Table 1.

Table 1. Descriptive Statistics on the Levels of Thinking Styles and Problem Solving Skills

Scale/Variable	Sub-Dimensions	N	$\bar{X}$	SD	$\bar{X}$/SD
Thinking Styles	1. Legislative	566	26.49	5.10	5.19
	2. Execution	566	27.14	5.79	4.68
	3. Judgment	566	25.98	5.80	4.47
	4. Monarchical	566	24.78	5.01	4.94
	5. Hierarchical	566	26.27	5.65	4.64
	6. Oligarchic	566	24.59	5.54	4.43
	7. Anarchic	566	25.06	5.16	4.85
	8.Global	566	24.07	5.38	4.47
	9.Local	566	24.11	5.33	4.52
	10. Internal	566	24.80	5.13	4.83
	11. External	566	24.70	5.58	4.96
	12. Liberal	566	25.28	5.40	4.68
	13. Conservative	566	23.49	5.85	4.01
	Total	566	326.83	48.59	6.72
Problem Solving Skills	Total	566	138.71	27.21	5.09

According to Table 1, the average of legislative sub-dimension is $\bar{X}$=5.19, that of executive sub-dimension is $\bar{X}$=4.68; that of judgment sub-dimension is $\bar{X}$=4.47; that of monarchical sub-dimension is $\bar{X}$=4.94; that of hierarchical sub-dimension is $\bar{X}$=4.64; that of anarchic sub-dimension is $\bar{X}$=4.85; that of global sub-dimension is $\bar{X}$=4.47; that of local sub-dimension is $\bar{X}$=4.52; that of internal sub-dimension is $\bar{X}$=4.83; that of external sub-dimension is $\bar{X}$=4.96; that of liberal sub-dimension is $\bar{X}$=4.68 in the appropriate range. The average of oligarchic sub-dimension is $\bar{X}$=4.43 and the average of conservative sub-dimension is $\bar{X}$=4.01. The total average of problem-solving skills is $\bar{X}$=5.09.

Findings for the second research question

The second sub-problem of the research aims to determine whether university students' thinking styles and problem-solving skills level differ significantly according to gender, age and grade. The findings obtained in this direction are presented in Table 2.

Table 2. The T-Test Results According to the Variable of Gender

Scale/Variable	Sub-Dimensions	Gender	N	$\bar{X}$	SD	t	p
Thinking Styles	1. Legislative	Female	407	26.73	4.92	1.816	.127
		Male	159	25.87	5.50		
	2. Execution	Female	407	27.84	5.46	4.710	.041*
		Male	159	25.33	6.22		
	3. Judgement	Female	407	26.27	5.52	1.902	.086
		Male	159	25.24	6.42		
	4. Monarchical	Female	407	24.93	4.78	1.185	.069
		Male	159	24.38	5.55		
	5. Hierarchical	Female	407	26.88	5.59	4.143	.239
		Male	159	24.72	5.50		
	6. Oligarchic	Female	407	24.44	5.46	-1.060	.918
		Male	159	24.99	5.72		
	7. Anarchic	Female	407	24.94	5.02	-.876	.293

		Male	159	25.37	5.49		
	8. Global	Female	407	23.94	5.33	-.979	.281
		Male	159	24.43	5.51		
	9. Local	Female	407	23.93	5.12	-1.289	.123
		Male	159	24.57	5.83		
	10. Internal	Female	407	24.59	5.17	-1.597	.861
		Male	159	25.35	5.02		
	11. External	Female	407	24.59	5.50	-.768	.209
		Male	159	24.99	5.79		
	12. Liberal	Female	407	25.34	5.27	.461	.052*
		Male	159	25.11	5.76		
	13. Conservative	Female	407	23.23	5.92	-1.680	.827
		Male	159	24.15	5.65		
	Total	Female	407	327.71	45.97	.694	.016
		Male	159	324.56	54.80		
Problem Solving Skills	Total	Female	407	142.05	26.29	4.747	.220
		Male	159	130.19	27.74		

As seen in Table 2, when students' thinking styles and problem-solving skills are analysed in terms of gender, it is found that there is significant difference in thinking styles of female and male students (t=.694; p<.05). However, there is not a significant difference in problem solving skills (t=4.747; p>.05). The thinking styles of female students ($\bar{x}$=45.97) are higher than those of male students ($\bar{x}$=54.80). Additionally, there is not a significant difference in terms of gender in legislative, judgement, monarchical, hierarchical, oligarchic, anarchic, global, local, internal, external and conservative sub-dimensions (p>.05). However, there is a significant difference in terms of gender in execution and liberal sub-dimensions.

Table 3. The One-Way Anova Results for the Variable of Undergraduate Grade Level

Scale/ Variable	**Sub-Dimensions**	**Between/ Within Groups**	**Sum of Squares**	**df**	**Mean Square**	**F**	**p**
	1. Legislative	Between	14.026	3	4.675	.179	.911
		Within	14715.46	562	26.184		
	2. Execution	Between	129.54	3	43.182	1.289	.277
		Within	18833.14	562	33.511		
	3. Judgment	Between	22.809	3	7.603	1.902	.086
		Within	19011.07	562	33.828		
	4. Monarchical	Between	86.287	3	4.78	1.185	.069
		Within	14101.98	562	5.55		
Thinking Styles	5. Hierarchical	Between	89.575	3	5.59	4.143	.239
		Within	17949.42	562	5.50		
	6. Oligarchic	Between	36.969	3	5.46	-1.060	.918
		Within	17310.99	562	5.72		
	7. Anarchic	Between	47.218	3	5.02	-.876	.293
		Within	15002.23	562	5.49		
	8. Global	Between	69.497	3	5.33	-.979	.281
		Within	16291.92	562	5.51		
	9. Local	Between	27.55	3	5.12	-1.289	.123
		Within	16040.74	562	5.83		

	10. Internal	Between	25.985	3	5.17	-1.597	.861
		Within	14898.02	562	5.02		
	11. External	Between	23.09	3	5.50	-.768	.209
		Within	19606.62	562	5.79		
	12. Liberal	Between	4.991	3	5.27	.461	.062
		Within	16525.343	562	5.76		
	13. Conservative	Between	89.041	3	5.92	-1.680	.827
		Within	19296.452	562	5.65		
Problem Solving Skills	Total	Between	6434.750	3	26.29	4.747	.220
		Within	411201.5	562	27.74		

As seen in Table 3, when students' thinking styles and problem solving skills are analyzed in terms of undergraduate grade level, it is found that there is not significant difference in problem solving skills of students (F=4.747; p>.05). Additionally, there is not a significant difference in terms of grade in legislative (p=.911), execution (p=.277), judgement (p=.086), monarchical (p=.069), hierarchical (p=.239), oligarchic (p=.918), anarchic (p=.293), global (p=.281), local (p=.123), internal (p=.861), external (p=.209), liberal (p=.062) and conservative (p=.827) sub-dimensions (p>.05).

Table 4. The One Way Anova Results According to the Variable of Age

Scale/Variable	Sub-Dimensions	Between/ Within Groups	Sum of Squares	df	Mean Square	F	p
Thinking Styles	1. Legislative	Between	65.910	3	21.970	.842	.471
		Within	14663.58	562	26.092		
	2. Execution	Between	89.836	3	29.945	.892	.445
		Within	18872.856	562	33.582		
	3. Judgment	Between	13.915	3	4.638	.137	.938
		Within	19019.972	562	33.843		
	4. Monarchical	Between	66.336	3	22.112	.880	.451
		Within	14121.935	562	25.128		
	5. Hierarchical	Between	81.301	27.100	27.100	.848	.468
		Within	17957.702	31.953	31.953		
	6. Oligarchic	Between	87.777	3	29.259	.953	.415
		Within	17260.182	562	30.712		
	7. Anarchic	Between	40.951	3	13.650	.511	.675
		Within	15008.498	562	26.706		
	8. Global	Between	98.075	3	32.692	1.130	.336
		Within	16263.347	562	28.938		
	9. Local	Between	20.042	3	6.681	.234	.873
		Within	16048.262	562	28.556		
	10. Internal	Between	8.856	3	2.952	.111	.954
		Within	14915.153	562	26.539		
	11. External	Between	39.756	3	13.252	.423	.736
		Within	17589.970	562	31.299		
	12. Liberal	Between	78.444	3	26.148	.893	.444
		Within	16451.890	562	29.274		
	13. Conservative	Between	33.842	3	11.281	.328	.805
		Within	19351.651	562	34.434		
Problem Solving Skills	Total	Between	1044.959	3	348.320	.147	.932
		Within	13329,65	562	2371.825		

As seen in Table 4, when students' thinking styles and problem-solving skills are analysed in terms of age, it is found that there is not significant difference in problem solving skills of students (F=.147; p>.05). Additionally, there is not a significant difference in terms of age in legislative (p=.471), execution (p=.445), judgement (p=.938), monarchical (p=.451), hierarchical (p=.468), oligarchic (p=.415), anarchic (p=.675), global (p=.336), local (p=.873), internal (p=.954), external (p=.736), liberal (p=.444) and conservative (p=.805) sub-dimensions (p>.05).

Findings for the third research question

The third sub-problem of the research aims to determine whether there is a significant relationship between university students' thinking styles and their problem solving skills. The findings obtained in this direction are presented in Table 5.

Table 5. The Results of Pearson Correlation

	Thinking Style	Problem Solving	Legislative	Execution	Judgment	Monarchical	Hierarchical	Oligarchic	Anarchic	Global	Local	Internal	External	Liberal	Conservative
Thinking style	1	75**	68**	.69**	72**	68**	73**	69**	74**	62**	73**	64**	66**	74**	55**
Problem Solving		1	.70**	.80**	.70**	-.10	.10*	.75**	.71**	.70**	.77**	.63**	.20	.40	.80**
Legislative			1	.62**	.59**	.43**	.54**	.38**	.43**	.30**	.43**	.37**	.36**	.45**	.23**
Execution				1	.60**	.44**	.56**	.36**	.45**	.31**	.39**	.37**	.36**	.40**	.26**
Judgment					1	.46**	.54**	.47**	.50**	.32**	.46**	.34**	.40**	.49**	.25**
Monarchical						1	.49**	.43**	.43**	.48**	.42**	.43**	.32**	.41**	.36**
Hierarchical							1	.51**	.48**	.32**	.44**	.39**	.41**	.51**	.28**
Oligarchic								1	.53**	.41**	.48**	.35**	.36**	.49**	.37**
Anarchic									1	.43**	.56**	.46**	.44**	.55**	.36**
Global										1	.45**	38**	.39**	.38**	.40**
Local											1	.48**	.48**	.56**	.35**
Internal												1	.36**	.46**	.34**
External													1	.61**	.36**
Liberal														1	.32**
Conservative															1

As seen in Table 4, it is determined that there is a positive and highly significant relationship between students' thinking styles and problem solving skills (r=.719). Correlation coefficients indicate a low correlation if it is 0-0.29, a moderate correlation of 0.30-0.64, a high correlation of 0.65-0.85, and a very high correlation of 0.85-1.00 (Ural & Kılıç, 2013). When the sub-dimensions of thinking styles and problem solving are examined, it is determined that there is a positive and high significant relationship between university students' "total problem solving skills" and some sub-dimensions of thinking styles (legislative, execution, judgement, oligarchic, anarchic, global, local, conservative). Additionally, there is a moderate correlation between problem solving and internal subdimension of thinking style.

Findings for the fourth research question

The fourth sub-problem of the research aims to determine whether university students' thinking styles significantly predict their problem-solving skills. The findings obtained in this direction are presented in Table 6.

Table 6. Results of Regression Analysis

Independent variable	Dependent variable	B	Std. Error	(β)	t	p	R	R^2	F	p
Thinking Styles	Problem Solving	127.599 .410	5.471 .197	.087	23.32 2.087	.00 .03	,087[a]	,008	.4.320	,03[a]

a. Predictors: (Constant), Problem Solving Tendencies Total Dependent Variable: Thinking Style

As seen in Table 5, students thinking style dispositions significantly predict their problem solving (R=.087; R^2=.008) ($p<.05$). In other words, in the regression model, the linear relationship between students' thinking style dispositions (predictor/independent variable) and problem solving (predicted/dependent variable) is statistically significant. According to Cohen (1988), the effect size of ".10" explains 1% of the total variance a common effect. The effect size of ".30" explains 9% of the total variance, and this is a moderate effect. The effect size of ".50" explains 25% of the total variance which is expressed as a high effect (Field, 2009). The results for this research shows that there is a high effect.

Discussion and Conclusions

The finding that students' thinking styles and problem-solving skills did not show a significant difference according to class level implies that the development of these skills may not be significantly influenced by the duration of education. Research has shown that thinking styles can have a significant impact on problem-solving skills. For example, a study found that students who demonstrated a more positive attitude towards mathematics were more likely to engage in effective problem-solving strategies, leading to higher levels of achievement (Hannula, 2002). However, It should be noted that thinking styles and problem-solving skills are under the influence of many factors such as individual differences and teaching methods (Sternberg, 1997; Jonassen, 1997). Additionally, according to recent research, age is not a determining factor in the connection between thinking styles and problem-solving abilities among university students (Akan & Günek, 2021). This means that regardless of age, students' thinking styles impact their problem-solving abilities. The research findings also indicate the level of students' thinking styles and problem-solving skills has been observed to be at a moderate level. It is important to note that thinking styles and problem-solving skills are complex and multifaceted concepts that are influenced by a variety of factors, including education, experience, and individual differences (Sternberg, 1997; Jonassen, 2000; Zhang & Sternberg, 2005).

The research findings indicate a significant difference in thinking styles and problem-solving skills between students based on gender. Several studies suggest that there are differences between gender and thinking styles/problem-solving skills. Hyde, Fennema, and Lamon (1990) conducted a meta-analysis examining gender differences in mathematical problem-solving skills. The study found that there are some gender

differences, with male students generally exhibiting higher performance in mathematical problem-solving compared to female students. Voyer, Voyer, and Bryden (1995) conducted a study exploring gender differences in spatial abilities and their relationship to mathematical problem-solving skills. The research suggested that males tend to have superior spatial abilities compared to females, and this difference is associated with mathematical problem-solving skills. Stoet and Geary (2013) evaluated gender differences in mathematical and reading achievement using PISA data. The researchers found an inverse relationship between mathematics and reading, suggesting that gender differences in mathematics are related to gender differences in reading. However, it should be noted that the results of studies assessing the relationship between gender and thinking styles/problem-solving skills are inconsistent, and there are variations among studies. Some studies suggest that gender differences are insignificant or more influenced by social and cultural factors. One study found that men and women tended to approach mathematical problem-solving tasks differently, with women being more likely to use a relational approach while men were more likely to use an analytical approach (Ramirez, et al., 2013). However, it is important to note that individual differences within gender groups are significant and should not be ignored. Additionally, the relationship between thinking styles and problem-solving skills is complex and may be influenced by various factors, including education, culture, and personal experience. In terms of the effect of thinking styles on problem-solving skills, research suggests that individuals who possess a diverse range of thinking styles tend to have stronger problem-solving skills. Shortly, while there may be some differences in thinking styles and problem-solving skills based on gender, individual differences and other factors should also be considered. Furthermore, possessing a diverse range of thinking styles may be beneficial for developing stronger problem-solving skills.

In this study, it was concluded that there exists a significant correlation between students' cognitive styles and their problem-solving abilities. The statement suggests that there is a strong relationship between the thinking styles of university students and their problem-solving skills. Several studies have examined this relationship and found evidence to support the claim. For instance, a study by Abdi (2012) explored the relationship between thinking styles and problem-solving skills among students. The results of the study revealed that students' thinking styles had a significant impact on their problem-solving skills. Similarly, Prabhu and Ranganathan (2008) investigate how different cognitive styles influence problem-solving performance with multimedia-based learning materials. Jonassen (1997) explores the impact of cognitive style on problem-solving performance in well-structured and ill-structured learning tasks. Felder and Silverman (1988) examine the relationship between students' cognitive styles and their performance in engineering problem-solving tasks. Jung and Lee (2013) explore the relationship between cognitive styles and problem-solving ability in an online learning environment. Ismail and Baharom (2019) examine the correlation between cognitive styles (intuitive and analytic) and problem-solving abilities among engineering students. All these studies show a significant correlation between students' cognitive styles and their problem-solving

This research has shown that students' thinking styles have a significant impact on their problem-solving abilities. Similarly, Orhan (2022) in a study gets medium relationship

between critical thinking and problem solving. Also, Setiwan et al. (2020) indicate that cognitive style has a significant effect on reasoning and problem-solving abilities. Pereira (2014) conducted a study examining the relationship between critical thinking skills and problem-solving performance among adult learners. The results of the study demonstrated a positive and significant correlation between critical thinking skills and problem-solving performance, suggesting that individuals with stronger critical thinking skills were more effective in solving complex problems. More recently, Song et al. (2022) investigated the relationship between critical thinking disposition, critical thinking skills, and problem-solving abilities among university students. Their findings indicated that both critical thinking disposition and critical thinking skills were positively associated with problem-solving performance, highlighting the integral role of critical thinking in effective problem-solving. In line with these findings, Kanbay and Okanlı (2017) conducted a study investigating the relationship between critical thinking and problem-solving abilities among undergraduate students. Their results revealed a positive correlation between the two constructs, suggesting that individuals with higher levels of critical thinking tend to exhibit better problem-solving skills. Similarly, Lismayani et al. (2017) explored the association between critical thinking disposition and problem-solving performance in a sample of secondary school students. Their findings indicated a significant positive relationship between critical thinking disposition and problem-solving abilities, indicating that students with stronger critical thinking disposition demonstrated higher levels of problem-solving proficiency.

Recommendations

Based on the findings of the study, several recommendations can be proposed to enhance problem-solving skills among university students. Firstly, it is imperative to raise awareness among educators regarding the intricate relationship between students' thinking styles and their problem-solving abilities. Educators should be equipped with an understanding of how different thinking styles impact problem-solving and should subsequently incorporate appropriate teaching strategies tailored to accommodate these diverse thinking styles. By doing so, educators can effectively facilitate the development of problem-solving skills among students. Additionally, when designing interventions aimed at improving students' problem-solving skills, it is crucial to consider gender differences. Further investigation is warranted to explore the underlying reasons for the observed significant difference in problem-solving skills between male and female students. Subsequently, interventions can be developed based on these findings, catering to the specific needs and challenges faced by each gender.

Although the study did not identify any significant differences in problem-solving skills across different class levels, it is still recommended that educators concentrate on enhancing problem-solving abilities across all class levels. This can be achieved by integrating problem-based learning approaches and critical thinking activities into the curriculum. Such methods encourage students to actively engage in problem-solving tasks, fostering the development of their analytical and problem-solving capacities. Moreover, the study did not ascertain a significant effect of students' age on their problem-solving skills. However, it is essential to acknowledge that age may still play a role in the development of problem-solving abilities among university students. To further comprehend the influence of age, additional research should be conducted to

investigate the relationship between age and problem-solving skills specifically within the university student population.

To conclude, the results of this study underscore the noteworthy impact of students' thinking styles on their problem-solving skills. Therefore, educators should be cognizant of the individual differences in students' thinking styles and incorporate interventions that are tailored to address these variations, with the ultimate aim of improving problem-solving skills. By doing so, educators can foster a conducive learning environment that effectively nurtures and enhances the problem-solving capabilities of university students.

Peer-Review	Double anonymized - Two External
Ethical Statement	*It is declared that scientific and ethical principles have been followed while carrying out and writing this study and that all the sources used have been properly cited.* * (Afyon Kocatepe University Rectorate, Social and Humanities Scientific Research and Ethics Committee Decision was taken with the decision dated 27.01.2023, numbered 13 of the Presidency of the Publication Ethics Committee.)
Plagiarism Checks	Yes - Ithenticate
Conflicts of Interest	The author(s) has no conflict of interest to declare.
Complaints	itobiad@itobiad.com
Grant Support	The author(s) acknowledge that they received no external funding in support of this research.
Author Contributions	Design of Study: 1. Author (%50), 2. Author (%50) Data Acquisition: 1. Author (%80), 2. Author (%20) Data Analysis: 1. Author (%20), 2. Author (%80) Writing up: 1. Author (%50), 2. Author (%50) Submission and Revision: 1. Author (%60), 2. Author (%40)
Değerlendirme	İki Dış Hakem / Çift Taraflı Körleme
Etik Beyan	*Bu çalışmanın hazırlanma sürecinde bilimsel ve etik ilkelere uyulduğu ve yararlanılan tüm çalışmaların kaynakçada belirtildiği beyan olunur.* *(Afyon Kocatepe Üniversitesi Rektörlüğü, Sosyal ve Beşeri Bilimleri Bilimsel Araştırma ve Yayın Etiği Kurulu Başkanlığının 27.01.2023 Tarih , 13 Nolu kararı ile Etik Kurul Kararı alınmıştır.)
Benzerlik Taraması	Yapıldı – Ithenticate
Etik Bildirim	itobiad@itobiad.com
Çıkar Çatışması	Çıkar çatışması beyan edilmemiştir.
Finansman	Bu araştırmayı desteklemek için dış fon kullanılmamıştır.
Yazar Katkıları	Çalışmanın Tasarlanması: 1. Yazar (%50), 2. Yazar (%50) Veri Toplanması: 1. Yazar (%80), 2. Yazar (%20) Veri Analizi: 1. Yazar (%20), 2. Yazar (%80) Makalenin Yazımı: 1. Yazar (%50), 2. Yazar (%50) Makale Gönderimi ve Revizyonu: 1. Yazar (%60), 2. Yazar (%40)

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