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Research Paper

The effect of thinking styles on creative personality traits of pre-service teachers

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Abstract. This study aims to evaluate the predictive effects of creative personality traits on thinking styles. In addition to this main purpose, the demographic characteristics of pre-service teachers (gender, grade level, socio-economic level) and their differences in creative personality traits and thinking styles were also analysed. The comparative relational survey model, one of the quantitative research methods, was used in the study. In this study, the snowball sampling method was preferred to reach the individuals attending university in Istanbul and who have not graduated yet and will work with children in early childhood. 186 pre-service teachers participated in the study. 91.4% of the participants were female and 8.6% were male. The ages of the participants ranged between 18 and 49, with an average age of 22.41. "Sternberg-Wagner Thinking Styles Scale" and "Creative Personality Traits Scale" were used as data collection tools. The study analyzed the effect of thinking systems on creative personality traits with a "stepwise" regression model. As a result, it was found that "global", "judicial", "monarchical" and "conservative" dimensions were effective on "goal orientation"; "Liberal" and "Executive" dimensions were effective on "intrinsic motivation"; "Global" and "Legislative" dimensions were effective on "self-confidence" and "Liberal" dimension was effective on "risk-taking".

Keywords: Creative personal traits, thinking styles, pre-service teachers.

INTRODUCTION

In Turkey, “creativity” is etymologically defined as "having the ability to create" or a hypothetical predisposition that is accepted to exist in every individual, leading to creating something (Gülensoy, 2011). Similarly, creativity, which is referred to as "creativity" in English, comes from the root "create" in English, that is, from the function or quality of creating (Harper, 2024). In this context, it may be interesting to look at the place of creativity in human history to have more detailed information about creativity, which is approached as people producing new things. In this context, it can easily be seen how high the impact and power of creativity is. It would not be wrong to say that the drawings made since the first human being, the discovery of fire, the invention of the wheel, the technology from the invention of the wheel to the artificial intelligence that has come today, and what has been done in the business world are the products of people's creative intelligence.

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Although studies on creativity date back to ancient times, it can be said that modern studies on creativity coincide with the 20th century. Studies on creativity date back to the early 1950s (Barron & Harrington, 1981; Hernández-Torrano & Ibrayeva, 2020; Ryhammar & Brolin, 1999). In 1956, the first national conference on creativity was a turning point in this field (Barron & Harrington, 1981). The psychology of creativity has evolved from early attempts to understand it through Freud and rationalist responses to current approaches focusing on personality, computational models, motivation, social psychology and group creativity (McIntyre *et al*., 2018).

Creative personality traits

Creative personality traits are defined by their openness to

non-traditional ways of thinking and new ideas. There have been many studies on creative personalities and some of the studies have mentioned similar and some of them different creative personality traits. Creative individuals tend to be open to new experiences, less traditional, more self-confident, self-accepting, ambitious, and impulsive (Feist, 1998). In addition, independence, high goals and strong symbolic interests are general characteristics of creative personalities. Creative individuals are generally concentrated in artistic and researcher professions (Helson, 1996). It can be said that creative people also have a high excitement of discovery, a more persistent structure in their work and a high level of co-operation. In addition, it can be expected that their harm avoidance behaviours are lower than others and they may have self-direction skills (Chávez-Eakle *et al*., 2006).

Thinking styles

Individuals' preferences for processing information and coping with tasks are considered as thinking styles. Thinking styles are related to personality traits and emotional states. They play an important role in areas such as academic performance and career decisions.

Thinking and learning styles are the source of individual differences in academic performance, and these differences are not related to abilities but to how people prefer to learn. There are alternative theories of thinking and learning styles, but they all have a common goal; to explain individual performance differences that cannot be explained by ability (Zhang & Sternberg, 2000).

Research on thinking styles in the educational context has revealed several findings. Firstly, students' thinking styles vary as a function of their personal characteristics and learning environments. Secondly, teachers' thinking styles, as manifested in teaching, differ depending on their personal characteristics, teaching experiences and school environment. Lastly, students tend to achieve better academic results when students' thinking styles match their teachers' (Zhang, 2002).

Different thinking styles contribute significantly to academic performance and equally talented individuals perform better in different assessment environments (Grigorenko and Sternberg, 1997). In a study examining the relationship between thinking styles and cognitive development, it was found that students who reasoned at a higher level of cognitive development used a wider range of thinking styles than students who reasoned at a lower level of cognitive development (Zhang, 2002).

Creative personality traits and thinking styles

Creative individuals often exhibit flexibility in thinking, moving between different cognitive styles such as cerebral, limbic, right, and left modes, which is associated with higher creative personality scores and creative performance on design tasks (Meneely and Portillo, 2005). The ability to switch between personality traits such as extraversion and introversion and between intuitive and algorithmic thinking styles is characteristic of a "complex" personality associated with creativity (Haller and Courvoisier, 2010). Creative personality traits positively predict creative thinking tendencies, and this relationship is mediated by creative learning environments and teachers' behaviours that encourage creativity (Ayyıldız and Yılmaz, 2021). There is a positive relationship between creative personality traits and creative thinking skills (Halpin *et al*., 1974). In a study conducted by Bapoğlu (2010) with students attending primary schools, a high and positive finding was found between verbal and formal creativity and critical thinking. In another study, creative personality measures were associated with creative thinking abilities, and it was found that these characteristics may be important in promoting creativity (Halpin *et al.*, 1974).

These studies show that creative personalities are determined by a complex interaction of cognitive flexibility and certain personality traits. In addition, it is possible to say that the ability to adapt and transition between different thinking styles and personality traits is an important indicator of creativity. Abolghasem *et al.* (2016) reported that different thinking styles such as local, conservative, global, liberal, hierarchical, anarchic, internal, and external are positively and negatively related to students' creativity. Furthermore, Barron and Harrington (1981) emphasized that creativity is related to personality and intelligence and that these characteristics can be innate and can also be developed through education. Another study that addresses this kind of connection remotely is the study titled "Divergent Thinking as an Indicator of Creative Potential" by Runco and Acar (2012) which examined individuals' preferences for risky and original ideas and how these preferences change under factors such as time pressure and evaluation criteria. Tsutomu Harada's study titled "The effects of risk-taking, exploitation, and exploration on creativity" looked at the effects of risk-taking behaviour on creativity and analysed how risk-taking can affect creative thinking (Harada, 2020). However, no research directly linking thinking styles and creative personality traits has been found. The identified studies are either limited to literature information and creative thinking skills, or limited amount of creativity concepts. Based on the research in the literature and the views that it is possible to develop creative personality and thinking styles in education, this study aims to determine the predictive effects of pre-service teachers' thinking styles on creative personality traits. In this context, the predictive effects of pre-service teachers' creative personality traits, which constitute the sub-dimensions of "goal orientation", "intrinsic motivation", "self-confidence", "risk-taking", on "legislative", "executive", "judicial", "monarchic", "hierarchic", "oligarchic", "anarchic", "global", "local",

"internal", "external", "liberal", "conservative" thinking styles were evaluated. In addition to this main purpose, the demographic characteristics (gender, grade level, socio-economic level) of pre-service teachers were also analysed in terms of their creative personality traits and their differences in thinking styles.

METHODOLOGY

Research Model

In social sciences research, the relational survey model focuses on examining the relationships, mutual effects and changes between variables, while detailing methodological steps such as hypothesis formulation, sample selection, data collection and analysis (Bekman, 2022). Since the comparative correlational survey model is seen as an important tool for determining effective variables and understanding the relationships between them, it was deemed appropriate to use the comparative correlational survey model, one of the quantitative research methods, in this study.

Sample

Snowball sampling method was used in this study. Snowball sampling was introduced by Coleman (1958-1959) and Goodman (1961) to examine the structure of social networks and was later used as a convenience method to examine hard-to-reach populations (Heckathorn, 2011a; Heckathorn, 2011b). In this study, snowball sampling method was preferred to reach individuals who are attending universities in Istanbul and have not yet graduated and who will work with children in early childhood. In addition, snowball sampling method is successfully used in social sciences, especially in the study of social networks and social dynamics, which can produce a unique type of social knowledge (Noy, 2008). A total of 186 prospective early childhood teachers participated in the study. 91.4% of the participants were female and 8.6% were male. The ages of the participants ranged between 18 and 49, with an average age of 22.41. 48.4% of the participants were attending preschool education departments, 38.2% were attending child development and education departments and 13.4% were attending other departments. Of the participants, 13.4% were attending the first grade, 34.9% were attending the second grade, 22.6% were attending the third grade, and 26.3% were attending the fourth grade.

Data Collection Tools

Personal Information Form

In the personal information form prepared by the researcher, the gender, age, department, grade level, parental education level and perceived family economic level of the prospective teacher were included. Analyses were made on the variables that could be evaluated in the demographic structure.

Sternberg-Wagner Thinking Styles Scale

The "Thinking Styles Scale" developed by Sternberg and Wagner in 1992 was adapted into Turkish by Buluş in 2006. There are 65 items in the form adapted to Turkish. The scale items consist of 7 grades ranging from "not at all appropriate" to "completely appropriate". The scale has 13 sub-dimensions. The internal consistency coefficients of the sub-dimensions in the original article vary between .66 and .93 (Buluş, 2006). The names of the sub-dimensions and their reliability levels in this study are respectively: Legislative (.92), executive (.93), judicial (.92), monarchical (.82), hierarchical (.95), oligarchical (.85), anarchic (.83), global (.90), local (.87), internal (.89), external (.91), liberal (.94), conservative (.94).

Creative Personality Traits Scale

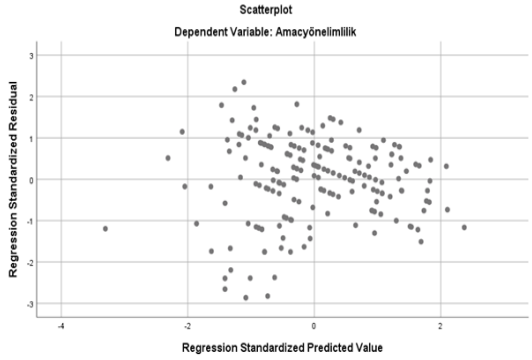
The "creative personality traits" scale created by Şahin and Danışman (2017) is a measurement tool for measuring the creative personality traits of culture-specific high school and university students. The scale consists of 17 items with 4 factors. The scale is a five-point scale ranging from "strongly disagree" to "strongly agree". The internal consistency coefficient of the scale is .67. The internal consistency coefficients of the sub-factors of the scale vary between .60 and .65. The names of the sub-dimensions and their reliability levels in this study are goal orientation (.84), intrinsic motivation (.90), self-confidence (.86), risk-taking (.79).

Data Collection Process

The sample consisted of undergraduate students attending the departments of "child development and education" and "pre-school education", which are trained to teach early childhood children, and (other) departments where they can continue their early childhood education. The measurement tool was sent to the undergraduate students attending the relevant departments in the whole province of Istanbul by the researcher via Google form. The students were asked to send it to the students in their circle of friends, who are attending different universities in Istanbul Province through social communication networks. In this way, the forms were sent to many universities in Istanbul. The forms were filled in voluntarily.

Analysing the Data

As a result of the analyses, it was accepted that the scale data were normally distributed since the kurtosis-



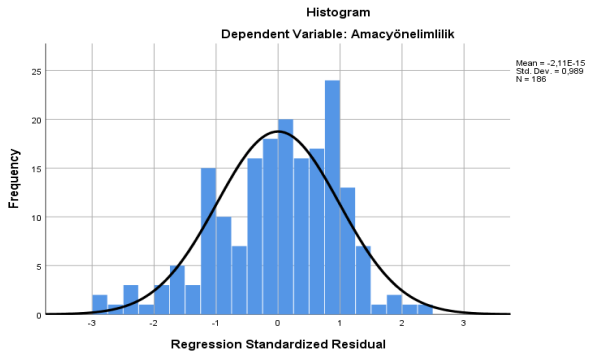
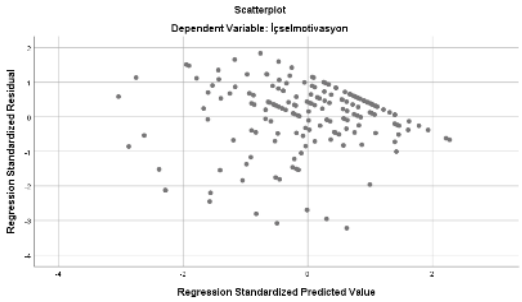


Figure 1. Goal orientation.



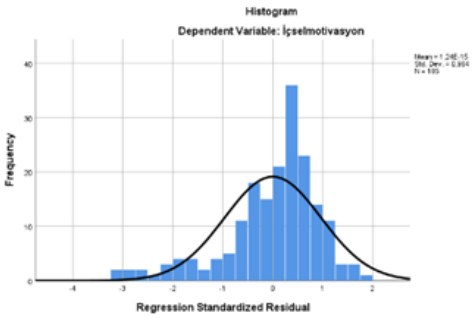


Figure 2. Intrinsic motivation.

skewness values in the sub-dimensions of "Sternberg-Wagner Thinking Styles Scale" and "Creative Personality Traits Scale" were between "-1.5" and "+1.5" values. The internal consistency levels of the scales were analysed and since Cronbach's alpha values (.79-.95) were quite high on the profile considered, there was no need to remove any sub-dimension. In the study, although the data were normally distributed in demographic data comparisons, non-parametric analyses were preferred since the number of items for each variable were below 30. When the research values are analysed, it is seen that all the multiple regression assumptions are met. These assumptions are summarised below:

1) Dependent and independent variables are continuous variables at equal interval measurement level
2) Normal distribution of variables
3) Linear relationship between variables
4) There is no multicollinearity between independent variables. The relationship between independent variables is below .80. “Variance inflation factor” (VIF) values must be below 10. The minimum VIF value of each variable in each model is 1.055 and the maximum VIF value is 2.857. Durbin Watson value is 2.116.
5) There should be no outliers. Std residuals’ expected values can vary between -3.29 and +3.29. - Cooks distance value should be maximum "1".
6) The errors of the estimates should be normally distributed.
7) There should be co-variance.
8) The assumption that the errors should be independent is also fulfilled.

The results proving the regression assumptions of the dependent variables are presented below;

Goal orientation

In the dimension of goal orientation, it is seen that the errors are normally distributed and there is co-variance (Figure 1). The minimum VIF value of each variable in each model is 1.055 and the maximum VIF value is 2.857. Durbin Watson value is 2.116. Std residual values. -2,864 and 2,346. Cooks distance value should be maximum "1", minimum ".000" and maximum ".048" in the research.

Intrinsic motivation

VIF value is max.1.691 and min.1.291; Durbin Watson value is 1.855. Expected between 1-3, there should be no outliers. The values obtained after removing the 15th data from the outliers are given (Figure 2). Std residual values

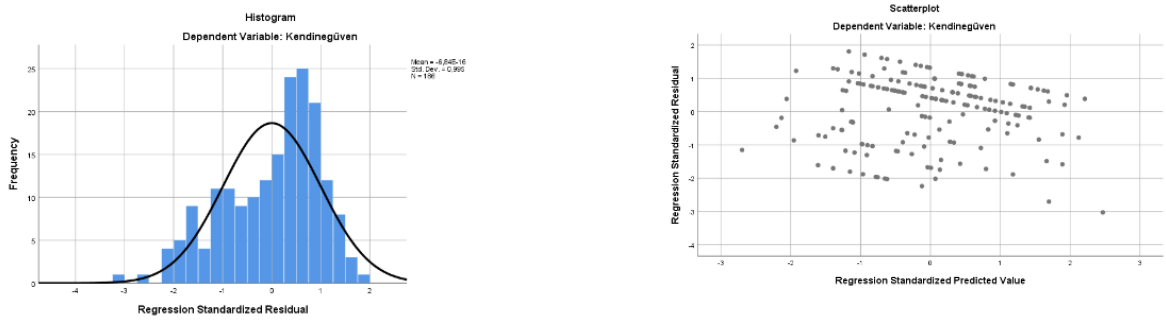


Figure 3. Confidence.

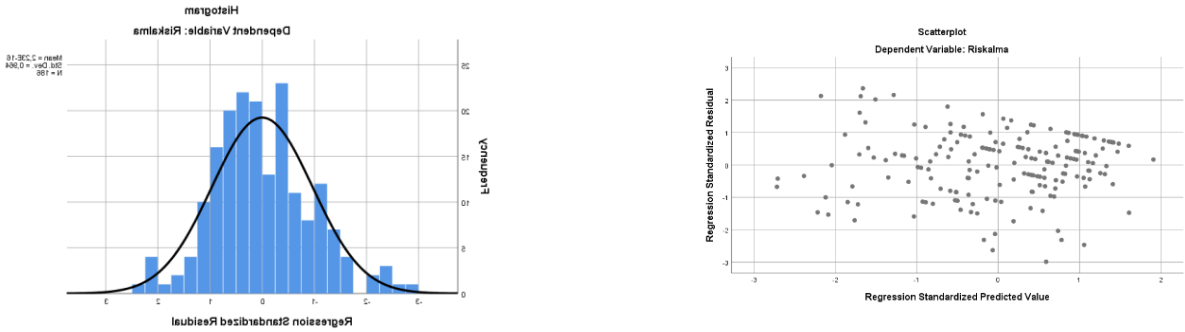


Figure 4. Risk-taking.

Table 1. Regression analysis results on the effect of "global", "judgemental", "monarchical" and "conservative" dimensions on "goal orientation"

Dependent Variable: Goal Orientation	**Model:** R^2=0,29; F=18.637; p=0,000		
Independent Variable	**β**	**t**	**p**
Constant	4.117	16,077	,000
Global	-.285	-3,406	,001
Judicial	.416	5,464	,000
Monarchical	-.219	-2,686	,008
Conservative	-.195	-2,370	,019

are -3,220 and 1,843. Cooks distance value should be maximum "1", minimum ".000" and maximum ".112" in the research.

Confidence

VIF value is between 2.536 and 1.284; Durbin Watson value is 2.110. Expected between 1-3, there should be no outliers. Std residual values are between -3.027 and 1.808 (Figure 3). Cooks distance value is between minimum ".000" and maximum ".130".

Risk-taking

VIF value is between 1.297 and 1.850, Durbin Watson value is 2.113. Expected between 1-3, there are no outliers. Std residual values are between -3,115 and 2,598 (Figure 4). Cooks distance value is between minimum ".000" and maximum ".108".

FINDINGS

The findings related to the purpose of the research as well as the thinking systems affected by each creative personality trait of pre-service teachers are given in the tables.

From Table 1, it is seen that the regression model is significant (F=18,637; p< .000) and "goal orientation" explains 29% of the variance. In addition, it was determined that the global (β=-.285; p<.001), monarchical (β=-.219; p<0.08), and conservative (β=-.195; p<0.019) dimensions of the thinking styles scale had negative

Table 2. Regression analysis results on the effect of "Liberal", and "Executive" dimensions on "Intrinsic Motivation"

Dependent Variable: Intrinsic Motivation	**Model:** R^2=0,356; F=50.245; p=0,000		
Independent Variable	**β**	**t**	**p**
Constant	1,557	5,949	,000
Liberal	,392	5,697	,000
Execution	,294	4,266	,000

Table 3. Regression analysis results for the effect of "Global" and "Legislative" dimensions on "Self-confidence"

Dependent Variable: Self Confidence	**Model:** R^2=0,143; F=16.425; p=0,000		
Independent Variable	**β**	**t**	**p**
Constant	3,810	10,031	,000
Global	-,388	-5,546	,000
Legislative	,187	2,677	,008

Table 4. Results of regression analysis on the effect of "Liberal" dimension on "Risk Taking"

Dependent Variable: Risk Taking	**Model:** R^2=0,221; F=53.530; p=0,000		
Independent Variable	**β**	**t**	**p**
Constant	**1,769**	6,865	,000
Liberal	,475	7,316	,000

Table 5. Kruskal Wallis-H Test Results to determine Whether the Scores of "Local-Rational" Thinking Style Scale Differ According to Perceived Income Level Variable.

	Groups	*N*	$\bar{x}_{sira}$	X^2	df	***p***	
Local	(1) Lower	10	48,70	11,801	2	.003	3>1
	(2) Middle	24	74,48				
	(2) Middle	24	74,48				3>1

effects on the "goal orientation" sub-dimension, and the judgemental (β=0.416; p<0.00) dimension had positive and significant effects on "goal orientation"(Table 1).

From Table 2, it is seen that the regression model is significant (F=50.245; p< .000) and "intrinsic motivation" explains 36% of the variance. In addition, it was determined that "liberal" (β=-.392; p<.001) and "executive" (β=-.294; p<0.00) dimensions of thinking styles scale had positive and significant effects on "intrinsic motivation" sub-dimension (Table 2).

From Table 3, it is seen that the regression model is significant (F=16.425; p< .000) and explains 14% of the variance of "Self-Confidence". In addition, it was determined that the "global" (β=-.388; p<.000) dimension of the thinking styles scale had a negative effect and the "legislative" (β=.187; p<0.08) dimension had a positive and significant effect on the "self-confidence" sub-dimension (Table 3).

From Table 4, it is seen that the regression model is significant (F=53.530; p< .000) and explains 22% of the variance of "Risk Taking". In addition, it was determined that the "liberal" dimension (β=-.475; p<.000), one of the dimensions of the thinking styles scale, had a positive and significant effect on the "risk-taking" sub-dimension (Table 4).

The findings related to the differences of pre-service teachers' creative personality traits and thinking systems according to their demographic characteristics are presented below;

When the sub-dimensions of creative personality traits and thinking styles of pre-service teachers were analysed, it was found that there was no difference according to gender, the department they were studying, parents' education level, class level and family economic level (except for Local thinking style).

In the variable related to perceived income level, the difference was found only in "local thinking style".

From Table 5, it was determined that there was a significant difference in the local thinking styles of pre-service preschool teachers according to the income level they perceived themselves (x^2=11.801; p=0,03). As a result of the Mann Whitney U test conducted to determine

which groups the difference was between, it was determined that the difference between the levels of "Local" thinking styles of the participants who perceived their income level as low ($\bar{x}$=48.70; df=2) and the levels of "Local" thinking styles of the participants who perceived their income level as upper ($\bar{x}$=99.45; df=2) was significant and in favour of those who perceived their income level as "upper". In other words, it can be stated that the levels of local thinking styles of the participants who perceive their income level as low are significantly lower than the participants who perceive their income level as high. There is a similar significant difference between the participants who perceive their income level as "upper" and the participants who perceive their income level as "lower". It is seen that the local thinking systems of the participants who perceive themselves at the "upper" socio-economic level are higher than the "lower" socio-economic level.

DISCUSSION AND SUGGESTION

It was found that "global", "judgemental", "monarchical" and "conservative" sub-dimensions of thinking styles predicted the "goal-orientation" dimension of creative personality traits. "Global", "monarchical" and "conservative" thinking styles have a negative effect on goal orientation, but "judgemental" thinking styles have a "positive" predictive effect on goal orientation. Although, there are no findings directly related to these thinking styles in the literature studies, but there are studies indirectly predicting creative personality traits and thinking styles. In goal content theories, it is mentioned that learners focus on what they aim to achieve, and "mastery goal" is described as a general learning mindset and is related to the standard performance level to be achieved, goal characteristics and goal selection (Cook & Artino, 2016). In addition, another study revealed that people who use creative thinking styles against uncertain situations are also more confident and prone to difficulties (Paloș *et al.*, 2011). This is one of the findings showing that judgemental thinking style is associated with self-confidence and the capacity to perform successfully.

In addition, it was determined that the "liberal" and "executive" dimensions of the thinking styles scale had positive and significant effects on the "intrinsic motivation" sub-dimension. "Liberal" thinking system is generally associated with a more creative (Fox *et al.*, 2013; Adler & Chen, 2011; Brase, 2014) and flexible (Crow & Henning, 2021) approach to problem-solving. On the other hand, the "Executive" thinking system is characterised by logical reasoning (Cherp, 2018), and strategic planning (Hellriegel and Slocum, 1975). Studies are showing that "Liberal" and "Executive" thinking systems can have an impact on intrinsic motivation (Sekhar *et al*., 2013).

It was determined that "global" thinking style had negative significant effects on "self-confidence" sub-dimension of creative personality traits, and "legislative" thinking style had positive significant effects on "self-confidence" sub-dimension of creative personality traits. In a study by Zhang (2002), it was found that "norm-compliant", "simpler thinking styles" were associated with "analytical" thinking style and more creative and more complex thinking styles were associated with "global (holistic)" style. The relationship between being global (holistic thinking) and creativity may be related to whether a person is inclined to creative and complex thinking, which in turn may be positively related to creative self-confidence. Research shows that individuals with high creative self-confidence tend to exhibit more innovative and creative behaviour at work. This means showing courage and taking action using one's own abilities and belief in them (Adeoya *et al.*, 2021). The relationship between self-confidence and holistic thinking suggests how these two traits can synergise with each other to contribute to innovation and creative problem-solving. In this context, creative self-confidence can potentially help a person to produce innovative outputs by enabling him/her to move more comfortably in holistic thinking processes and develop various ideas. Holistic thinking and self-confidence can be generally recognised as positively interacting and supporting each other.

However, in some cases, these characteristics may reverse and affect each other negatively. In this study, it was found that they negatively affect each other. If an individual's self-confidence is too high and this self-confidence is not based on his/her real abilities, it may be an unrealistic self-confidence and the person may make wrong decisions or underestimate risks. Also, holistic thinking, as well as having a broad perspective and evaluating alternatives, can sometimes lead to overlooking details, which can cause the individual to fail. At these points, it can be considered that high self-assurance and holistic thinking skills may lead to negative consequences. In addition, it was observed that the dimension of being "liberal" from thinking styles predicted the dimension of "risk-taking" from creative personality traits. At this point, when the related research are analysed, even if there are no studies directly related to this issue, studies in which opinions on liberal thinking are presented are not few. Liberal thinking is generally associated with characteristics such as open-mindedness, openness to new experiences and tolerance to various perspectives. It is known that risk-taking is an important characteristic of creative personalities and this requires the courage to explore and implement new ideas. It is possible that individuals with a liberal thinking style tend to accept more diverse and unconventional ideas and therefore are more likely to adopt risk-taking in creative processes. However, since creativity is a multidimensional phenomenon, no single characteristic alone can determine creativity and should be evaluated together with other factors. Creative personalities are generally characterised by features such as original thinking, independent decision-making, risk-taking and being energetic (Şahin and Danışman, 2017).

Risk-taking is an important feature of entrepreneurship and business development (Bozkurt, 2007; Kayalar & Ömürbek, 2007). Liberalism is characterised by its commitment to individual freedom and equality, rationality, and individualism (Bellamy, 2001). The liberal mindset can also be effective in creative thinking and risk-taking, thus supporting the tendency of creative personalities to develop new ideas and be innovative. Entrepreneurs can push boundaries by taking risks, challenge the status quo and ultimately innovate. The same principle applies to the development of a liberal mindset. It can be said that risk-taking and liberal thinking are closely related to creative personality traits. In this context, some elements of liberal thinking may be a supportive factor for risk-taking tendency in creative processes. This study conducted with pre-service teachers revealed the effect of liberal thinking style on risk-taking among creative personality traits in young people.

This study also analyses whether there is a difference between thinking styles and creative personality traits of pre-service teachers and their demographic structures. When the sub-dimensions of creative personality traits and thinking styles of pre-service teachers were analysed, it was found that there was no difference according to gender, the department they were studying, parents' education level, class level and family economic level (except logical (local) thinking style). In a study, gender differences in "Creative Thinking" are minimal and depends on the level of education; it was found that men with primary or secondary school graduates scored higher than women with the same level of education, but this is related to their own level of education (Hernández-Torrano & Ibrayeva, 2020), not the effect of their families' level of education. In addition, in another study, it was revealed that both genders have relative strengths and weaknesses in creative thinking; girls perform better than boys in depth of thinking, and boys perform better than girls in transcendental thinking (He and Wong, 2011). In addition, studies that found differences in thinking styles according to age range and gender were also found. In a study conducted in Brazil, Wechsler (2009) found that thinking styles differ between genders and age ranges; in particular, he found significant differences in "Cautious-Reflexive", "Maladaptive/Convergent", "Logical-Objective" and "Emotional-Intuitive" styles. Similarly, Qummer and Zamir (2020) found that gender was not a determinant differentiation variable in their study related to "thinking styles".

In this study, there was a difference in "logical-local" thinking style in terms of economic level. A study conducted by Zhang and Postiglone (2001) found that students aged 17-45 from families with high socio-economic levels had more complex thinking styles. Similarly, in a study revealing that socio-economic level makes a difference in thinking styles, students from high economic level families scored lower in executive, conservative and monarchical styles, while they scored higher in anarchic style (Fan and Zhang, 2014).

It seems possible to make some suggestions based on the results of the research. This study revealed that thinking styles affect creative personality traits. At this point, especially researchers can conduct more studies to better understand the effect of thinking styles on "goal orientation". How "global", "judgemental", "monarchic" and "conservative" thinking styles predict creative personality traits can be a separate research topic. In addition, education programs can be designed by the "judgemental" thinking style, which seems to improve pre-service teachers' "goal orientation".

The effect of "liberal" and "executive" thinking systems on "intrinsic motivation" was found. In this context, developing methods that will bring these thinking systems to the forefront in the execution of pre-service teachers' courses may make a difference in the "intrinsic motivation" of pre-service teachers. In addition, investigating the types of motivation before and after the courses with an experimental model can be determined as a research topic. Thus, providing scientific information about thinking systems and their effects on instructors will enrich learning environments.

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