AN INVESTIGATION OF THE FACTORS AFFECTING INNOVATION PERCEPTIONS OF MATHEMATICS, SCIENCE AND SOCIAL SCIENCES TEACHER CANDIDATES

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ABSTRACT: The aim of this study is to investigate the innovation perceptions of engineering and teacher candidates. The data collection tools are the Turkish version of the Individual Innovativeness Scale (IIS), and the Domestic Factors Inventory. Three factor ANOVA is the main data analysis technique. Results indicate that family attitude has a statistically significantly influence on innovativeness perceptions.

Keywords: Engineering education, teacher education, ınnovativeness perception,

INTRODUCTION

Creativity is defined as the capability or act of conceiving something original or unusual, while innovation is the implementation or creation of something new that has realized value to others (Hunter, 2013). Innovativeness, according to Hunter's distinction is being one step ahead of being creative as a result of the added value dimension. It is clear that there is a distinction between creativity and innovativeness, nevertheless in practice these words frequently are used interchangeably. There is evidence that creativity relates to organizational innovation and effectiveness (Amiable, 1996; Scott & Bruce, 1994). Studies on innovative/creative perception/self efficacy are generally are available in the areas of business and engineering education (e.g. Wang, & Lin, 2012; Sung & Choi, 2009; Stajkovic & Luthans, 1998; Scott & Bruce, 1994) but there is less concern on teachers' perceptions (e.g. Mathisen & Bronnick, 2009).

Because of the increasing interest in investigating creativity and innovation, in recent studies various predictors of creativity and individual innovativeness have been examined (Choi, 2007; George & Zhou, 2001; Lim & Choi, 2009; Tierney, Farmer, & Graen, 1999). Personality traits as a factor for innovation perception is a relatively new area of inquiry (Sung & Choi, 2009). To investigate the influence of personality variables on innovative/ creative performance the Big Five model of personality was a popular instrument which defines personality as consisting of five dimensions as the name implies (i.e. extraversion, agreeableness, conscientiousness, emotional stability, and openness to experience) (e.g. James & Mazerolle, 2002; McCrae & Costa, 1997; George & Zhou, 2001; Sung & Choi, 2009).

There is growing evidence that students' information processing is different than past in the present time. Managing complex and diverse nature of today's problems needs flexible people who have innovative ideas. Teachers, therefore, need to have innovative teaching skills to make ideas and content more interesting for teaching the 21st century skills as well as for designing their pedagogy to encourage their students to think creatively and innovatively. In other words, teachers are required to 'teach creatively' and 'teach creativity' at the same time (Azzam, 2009).

Aim of the Study

The aim of the present study is to investigate student teachers' perceptions about innovation in the general sense, not particularly limited to teaching. These descriptions of innovation perceptions will also be made with respect

to area of teaching (mathematics, science and social science). We also wish to explore the degree of relationship between personality characteristics and innovation perceptions.

METHOD

A quantitative research design was selected for this research study. The study collects data from a state university in Istanbul. The sample comprises of 189 second year students in the science teaching (n=69), mathematics teaching (n=62) and social sciences teaching (n=58) departments. These departments are in the first three in the rankings of the university entrance examination so these students are among the country's very successful teacher candidates. The data collection tools are the Turkish versions of the Individual Innovativeness Scale (IIS) (Kılıçer & Odabaşı, 2010) and the Big Five Personality Scale (Big5) (Morsümbül, 2004).

For the current study, correlational research design was used. The multiple linear regression (Frankel, Wallen, & Hyun, 2012) is the main technique for data analysis. The relationship between a single outcome variable (dependent) and at least two or more predictor variables (independent) are generally examined by a multiple linear regression approach (Creswell, 2003). In this study, we investigated between the relationships between the IIS (the single dependent variable) and five independent variables: the five subscales (extraversion vs. introversion, agreeableness vs. antagonism, conscientiousness vs. lack of direction, emotional stability vs. neuroticism, openness vs. closedness to experience) of the big5 personality inventory. The calculated reliability scores for the big5 subscales varies between 0.73 and 0.84 (Morsümbül, 2004), and it is 0.77 for the IIS (Table 1).

Table 1. Descriptive statistics and the reliability scores of IS and big5. (N=202)

	Scales	RS	Mean	SD
BF1	Agreeableness	0.747	23.96 /30.00	8.57
BF2	Extraversion	0.839	25.31 /30.00	3.52
BF3	Contentiousness	0.832	21.43 /30.00	4.20
BF4	Openness	0.805	22.13 /30.00	4.75
BF5	Emotional Stability	0.737	20.11 /30.00	4.00
Big5	Total	0.823		
IIS	Innovativeness	0,772	72.27 /100.00	4.27

FINDINGS

Descriptive statistics

Means and standard deviations of the big5 scale and IIS were calculated (Table 1) and the results indicated that highest score is in the extraversion (M=25.31) and the lowest is in the emotional stability subscales. The value of 72.27 in the IIS indicates an "early adapters" level (one level before the "innovators" level) (Kılıçer & Odabaşı, 2010) for the teacher candidates in general. Means and standard deviations were also calculated with respect to the subject area of teaching (Table 2) which yielded no noteworthy differences.

Table 2. Descriptive statistics with respect to the subject area of teaching

	Science Teaching		Mathematics Teaching		Social Sciences Teaching	
	M	SD	M	SD	M	SD
Agreeableness	24,70	3,18	23,90	2,81	23,06	4,68
Extraversion	19,21	4,89	18,71	4,82	18,74	5,04
Contentiousness	21,70	4,72	21,76	4,51	20,78	5,15
Emotional Stability	20,66	4,21	20,05	4,52	19,26	4,07
Openness	22,24	3,60	21,60	4,44	22,43	4,28
Innovativeness	72,51	8,38	71,14	7,86	70,43	9,99

Correlational analyses

The correlation coefficients were calculated to describe the isolated relationship between the dependent (IIS) and several independent variables (Huck 2011). The results of the calculations of the Pearson Product moment correlations indicated low to mediocre statistically significant relationships between innovativeness perception and all five personality traits.

Model fit with respect to innovation perception scores

The result of regression is a generalization, which represent the best prediction of dependent variable from several continuous independent variables (Thompson, 2008). We used, in the present study, a multiple linear regression model. Our dependent variable is the innovativeness perception (IIS) and we wished to investigate whether or not & if so, the degree to which the dependent variable is predictable from the independent variables, namely, the big5 personality traits, the family attitude, family size, the geographical origin and the department of the teacher candidate. We preferred to use the standard technique and put all the variables to the model initially and excluded the variables that did not fit to the model until reaching the equation that can optimally predict the dependent variable. Data were checked, before the analysis, for the regression's assumptions; i.e, normality of residuals, and multicollinearity threat.

Table 3. Pearson Correlation Coefficients between IIS and big5

		Extraversion	Agreeableness	Contientiousness	Openness	Emotional Stability	Innovativeness
Extraversion	Pearson R	1	0,094	0,020	,247(**)	,233(**)	,305(**)
	Sig. (2-tailed)		0,185	0,774	0,000	0,001	0,000
Agreeableness	Pearson R		1	,287(**)	,426(**)	,261(**)	,487(**)
	Sig. (2-tailed)			0,000	0,000	0,000	0,000
Contentiousness	Pearson R			1	0,135	0,024	,209(**)
	Sig. (2-tailed)				0,056	0,735	0,004
Openness	Pearson R				1	0,099	,612(**)
	Sig. (2-tailed)					0,163	0,000
E. Stability	Pearson R					1	,240(**)
	Sig. (2-tailed)						0,001
Innovativeness	Pearson R						1
	Sig. (2-tailed)						

We first found out that 47% of the variation in the dependent variable is explained by the independent variable. Moreover as the Durbin-Watson value of 1.832 is in between 1.5 and 2.5, we concluded that there is no autocorrelation in the residuals (Durbin & Watson, 1951) (Table 4). Moreover, the statistically significant F value of 32.78 in the IIS analysis of variance (ANOVA) table indicates that the model was statistically significant (Table 5).

Table 4: Model Summary (A)

				Change Statistics					
R	R Square	Adjusted R Square	Std. Error of the Estimate	Sig. F Change	R Square Change	F Change	df1	df2	Durbin-Watson
,686(a)	0,471	0,457	6,31910	0,471	32,777	5	184	0,000	1,832

Table 5. ANOVA results for in novation perception scores (A)

	Sum of Squares	Df	Mean Square	F	Sig.
Regression	6544,10	5,00	1308,82	32,78	,000
Residual	7347,30	184,00	39,93		
Total	13891,39	189,00			

Variance inclusion factor and tolerance values are considered as important criteria for the selection of the predictor variables to be included in the model: the maximum acceptable VIF value is 10 and minimum acceptable tolerance value is 0.1 (Cohen, Cohen, West, & Aiken (2003) (Table 6). As a result of the coefficient analysis, contentiousness variable from the big5 scale, and the last three demographic variables (family size, geographical background and subject area) were excluded from the model.

Table 6. Coefficient analysis (A)

	Unstandardized Coefficients		Standardized Coefficients			Correlations		
	B	Std. Error	Beta	t	Sig.	Part	Tolerance	VIF
(Constant)	17,25	4,32		4,00	0,00			
Extraversion	0,29	0,12	0,14	2,53	0,01	0,31	0,18	0,14
Agreeableness	0,54	0,15	0,23	3,51	0,00	0,49	0,25	0,19
Contientiousness	0,14	0,10	0,08	1,34	0,18	0,21	0,10	0,07
Openness	0,97	0,13	0,46	7,42	0,00	0,61	0,48	0,40
Emotional Stability	0,18	0,11	0,09	1,59	0,11	0,24	0,12	0,09

As the b (unstandardized) weights and β (standardized) weights and structure coefficients for each predictor variable of the IIS score indicated, the resulting regression equations will appear as:

- *IIS = 17.25 + (0.29)*(Extraversion) + (0.54)* (Agreeableness) + (0.14)*(Contentiousness) + (0.97)*(Openness) + (0.18)*(Emotional Stability)*
- Z_{IIS} *= (0.14)*(Extraversion) + (0.23)* (Agreeableness) + (0.08)*(Contentiousness) + (0.46)*(Openness) + (0.09)*(Emotional Stability)*

DISCUSSION and CONCLUSION

Although the statistical model emerged as a result of the analysis of the predictor variables is not a powerful one and are unable to explain 53% of the variance in the individual innovativeness perception, it still provides useful information on the relationship between the innovativeness perception and the personality variables. It does indicate that the personality characteristics (if effectively measured) can be used to identify people with high attitudes towards innovation.

The relationship between perception and performance is not always straightforward as the general literature indicates (Johnston & Heineke, 1998) that we cannot claim that those with high attitudes are those with high performance. There is, nevertheless, evidence that innovation perception is a strong predictor of innovation performance (Kiliçer & Odabaşı, 2010). As the scores of IIS indicate, teacher candidates in general are in level 4 which corresponds to the "early adapters" level. It was thought that the epistemological differences among areas of teaching would make a difference in the IIS scores. It did not. No noteworthy difference was observed among areas of teaching as the IIS scores were in the 70,43-72,51 interval with a slight difference in favor of science teacher candidates (Social STC < Mathematics TC < Science TC).

Openness to experience emerged to be the most important personality factor among others. The result of the regression model shows that among the five personality variables, the one with the highest regression coefficient is the *openness to experience* (B=0.97) (Table 6). *extraversion, agreeableness, contentiousness* and *emotional stability* had lower coefficient values.

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