A Quantitative Investigation of the Factors Affecting Innovation Perceptions of Teacher Candidates

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ABSTRACT

The aim of this paper is to investigate the innovation perceptions of teacher candidates. The sample comprises of 189 second year students in the science, mathematics and social sciences teaching departments. The data collection tools are the Turkish version of the Individual Innovativeness Scale (IIS), and the Domestic Factors Inventory. Regression analysis is the main data analysis techniques. Results yielded a regression model in which the most powerful determinant for innovation perception emerged as openness to experience.

KEYWORDS: Innovativeness perception, Personality variables, Teacher education,

Öğretmen Adaylarının Yenilikçlik Algılarını Etkileyen Etkenler Üzerine Nicel bir Araştırma

ÖZ

Bu çalışmanın amacı öğretmen adaylarının yenilikçilik algılarını araştırmaktır. Çalışmaya fen bilimleri, matematik ve sosyal bilimler öğretmenliği alanlarından 189 öğretmen adayı katılmıştır. Veri toplama araçları Biriysel Yenlikçilik Ölçeği'nin Türkçe versiyonu ve ailesel etkenler envanteridir. Regresyon analizi veri analizi yöntemi olarak kullanılmıştır. Analizin ikinci

döngüsü sonucunda yenilikçilik algısının en güçlü yordayıcısı olarak tecrübeye açıklık değişkeni ortaya çıkmıştır.

ANAHTAR KELIMELER: Yeilikçilik algısı, Kişilik değişkenleri, Öğretmen eğitimi

Introduction

Teacher training carry a vital role in the development of the 21st century skills and positive attitudes towards innovation in the next generation. Developing innovation/entrepreneurship skills is important for a country's vision for its integration to the technologically developed international community. Preservice training of future science and mathematics teachers is especially important since the highly qualified technology workforce is the outcome of high quality education at the pre-university level.

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 realised 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 organisational 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

Studies on attitudes and performance related to innovation are generally available in the areas of business and engineering education (e.g. Wang, & Lin, 2012; Stajkovic & Luthans, 1998) but there are less work in the area of education (e.g. Mathisen & Bronnick, 2009). Public tendency about innovativeness is to link it more to the quantitative sciences. People in the social sciences are generally perceived to be as more conservatively oriented (Shermer, 2016, March 01) and as having distanced from technological advances. It is acknowledged that those being trained as teachers may not fully represent all the social sciences people. We still think that studying the innovation perceptions of student teachers in the area of social sciences (i.e. teacher of social studies) can be one way of exploring the degree of truth in this generalisation. Similar arguments can be put forward for the relationship between students in science majors and science teacher candidates and for mathematician candidates and mathematics teacher candidates. Another interesting issue here is the epistemological differences amongst the areas mathematics, hard sciences and social sciences. For instance, knowledge generation in hard sciences (e.g. physics) is based more likely on inductive methods, whereas in mathematics deductive thinking is dominant (Yıldirim, 1988). Although when it comes to pedagogy of these areas, epistemological differences tend to vanish (Robson, 1993), we believe, it is still worth exploring the possible differences.

There is evidence that innovation perception is related to personality variables (James & Mazerolle, 2002; Sung & Choi, 2009). There is an obvious evidence of a strong relationship in the literature between individuals' family background variables and their educational development (Gottfried, Fleming, & Gottfried, 1994; Grolnick,

Friendly, & Bellas, 2009). There is, however, less concern on other variables that can shape personality as possible predictors of innovation perception and/or performance. Family attitude towards the student is one such variable for which the distinction is generally made between protective, oppressive or democratic attitudes. Geographical background and family type are other two variables of such kind that might have an influence of some degree. Therefore, we also wish to explore if such a relationship exists between domestic factors including family attitude, family type and geographical background (Table 1).

Table 1. Options in the domestic factors inventory

Family Attitude	**Geographical Background**	**Family Type**
Protective	Village-Small town	Big family
Democratic	Big city	Nuclear family
Oppressive	City	Other
Inconsistent behavior		

In the light of these arguments, 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 how teacher candidates' personality characteristics and domestic factors are related to their 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), the domestic factors inventory which is comprised of three fully structured questions: (1) How do you describe your family attitude towards yourself? (2) What type of location were you raised in? and (3) What is your family type? (Table 1) and the Big Five Personality Scale (Big5) (Morsümbül, 2004).

For the current study, correlational research design was used. Descriptive statistics, correlational statistics and multiple linear regression (Frankel, Wallen, & Hyun, 2012) is the main techniques for data analysis. Correlation coefficients between the dependent and independent variables were calculated before the regression 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 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 three domestics factors and department of study. 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 2).

Table 2. 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

3. 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 3) which yielded no noteworthy differences.

Table 3. Descriptive statistics with respect to the subject area of teaching

	Science Teaching		Mathematics Teaching		Social Sciences Teaching	
	M	SD	M	SD	M	SD
Agreeableness	24,7	3,18	23,9	2,81	23,06	4,68
Extraversion	19,21	4,89	18,71	4,82	18,74	5,04
Contentiousness	21,7	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	3,6	21,6	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 (Table 4).

Table 4. Pearson Correlation Coefficients (R) between IIS and Big5 (Two tailed)

	Ag	Ex	Co	ES	Op	In	DoS	FA	FB	GB
Agreeableness	1.00	.072	.31?**	.25?**	.44	.49**	-.163**	-.131	-.06	.07?
Extraversion		1.00	.20(	.26?**	.22 **	.29**	-.045	'.005	-.07	.14?
Concentiousness			1.00	.06(	.14 **	.22**	-.074	-.099	.09	-.07?
Emotional Stability				1.00	.09	.22**	-.153**	-.182**	-.09	.05?
Openness					1.00	.62**	.039	.042	-.00	.07?
Innovativeness						1.00	-.089	.116	-.07	.05?

Department of study	1.00	.036	-.10	-.18*
Family Attitude		1.00	-.04	-.03
Family Background			1.00	.07
Geographical background				1.00
** Significant at p<.005				

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 and if so, the degree to which the dependent variable is predictable from the independent variables, namely, the big5 personality traits, domestic factors including family attitude, family type and geographical background, and the department of the teacher candidates. 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.

Regression statistics -First run

In the first run of the regression statistics all of the independent variables were included. It was found that 50% of the variation in the dependent variable is explained by the independent variable. Moreover as the Durbin-Watson value of 1.841 is in between 1.5 and 2.5, we concluded that there is no autocorrelation in the residuals (Durbin & Watson, 1951) (Table 5). Moreover, the statistically significant F value of 18.370 in the IIS analysis of variance (ANOVA) table indicates that the model was statistically significant (Table 6).

Table 5: Model Summary (First run)

			Std.	Change Statistics					
			Error of		R				
	R	Adjusted	the	Sig. F	Square	F			Durbin-
R	Square	R Square	Estimate	Change	Change	Change	df1	df2	Watson
0,703	0,495	0,468	6,392	0,495	18,370	9	169	0,000	1,841

Table 6. ANOVA results for innovation perception scores (First run)

	Sum of Squares	df	Mean Square	F	p
Regression	6.756.39	9	750.71	18.37	0.00

Residual	6.906.44	169	40.86
Total	13.662.83	178	

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 7). Results indicate that VIF values are acceptable to be included in the model but three independent variables, *family background*, *geographical background*, and *department of study* failed have tolerance values less than 0.1. Hence they were excluded from the model.

Table 7. Coefficient analysis (first run)

	Unstandardised Coefficients		Standardised Coefficients	t	p	Correlations		
	B	Std. Error	Beta			Part	Tolerance	VIF
(Constant)	25.051	5.894		4.251	0			
Agreeableness	0.569	0.165	0.236	3.440	0.001	0.492	0.256	0.188
Extraversion	0.245	0.105	0.137	2.327	0.021	0.286	0.176	0.127
Concentiousness	0.175	0.109	0.095	1.604	0.111	0.219	0.122	0.088
Emotional Stability	0.165	0.122	0.081	1.354	0.178	0.218	0.104	0.074
Openness	0.96	0.138	0.448	6.944	0	0.615	0.471	0.38
Family Attitude	1.506	0.534	0.160	2.822	0.005	0.116	0.212	0.154

Family Background	-1.058	1.598	-0.037	-0.662	0.509	-0.065	-0.051	-0.036
Geographical Background	0.079	0.732	0.006	0.107	0.915	0.058	0.008	0.006
Department of study	-0.305	0.409	-0.043	-0.745	0.457	-0.089	-0.057	-0.041

Regression statistics -Second run

After the exclusion of the three independent variables, the regression statistics was redone with the remaining variables, i.e. *five domains of Big5* and *family attitude.* It was found 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, it was concluded that there is no autocorrelation in the residuals (Durbin & Watson, 1951) (Table 8). 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 9).

Table 8: Model Summary (Second run)

			Std. Error of	Change Statistics					
					R				
R	R Square	Adjusted R Square	the Estimate	Sig. F Change	Square Change	F Change	df1	df2	Durbin-Watson
0.686	0.471	0.457	6.319	0.471	32.777	5	184	0.000	1.832

Table 9. ANOVA results for innovation perception scores (Second run)

	Sum of Squares	df	Mean Square	F	p
Regression	6544.10	5.00	1308.82	32.78	.00
Residual	7347.30	184.00	39.93		
Total	13891.39	189.00			

Variance inclusion factor and tolerance values were recalculated for the selection of the predictor variables to be included in the model and for understanding whether or not a third run is necessary: It was found that the VIF values and tolerance value are within the acceptable limits (Cohen et al, 2003) (Table 10). It is concluded that the model includes all of the six independent variables.

Table 10. Coefficient analysis (second run)

	Unstandardised Coefficients		Standardised Coefficients	T	p	Correlations		
	B	Std. Error	Beta			Part	Tolerance	VIF
(Constant)	21.807	4.289		5.084	0.000			21.807
Agreeableness	0.604	0.160	0.251	3.769	0.000	0.667	1.500	0.604
Extraversion	0.253	0.104	0.141	2.430	0.016	0.876	1.141	0.253

Concentiousness	0.167	0.106	0.091	1.572	0.118	0.885	1.130	0.167
Emotional Stability	0.179	0.121	0.088	1.483	0.140	0.848	1.179	0.179
Openness	0.942	0.136	0.439	6.934	0.000	0.736	1.358	0.942
Family Attitude	1.533	0.528	0.163	2.903	0.004	0.941	1.063	1.533

As the p values indicate the independent variables, *emotional stability* and *contentiousness'* are not reliable predictors for the IIS ($p>0.05$). Beta scores show that the strongest predictor for IIS is the *openness to experience*, (Beta=0.439), followed by the *family attitude* (Beta=0.163). As the B (unstandardised) weights and β (standardised) weights and structure coefficients for each predictor variable of the IIS score indicated, the resulting regression equations will appear as:

- *IIS = 21.81 + (0.60)* (Agreeableness) + (0.25)*(Extraversion) + (0.17)*(Contentiousness) +*
  (0.18)(Emotional Stability) + (0.94)*(Openness) + (1.53)*(Family Attitude)*
- Z_{IIS} *= (0.25)* (Agreeableness) + (0.14)*(Extraversion) + (0.09)*(Contentiousness) +*
  (0.09)(Emotional Stability) + (0.44)*(Openness) + (0.16)*(Family Attitude)*

Discussion and conclusion

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; Çuhadar, et al, 2013). The positive perception in terms of readiness for innovation, was also reported to have a significant correlation with performance like other variables (proactive personality, generalised self-efficacy, stress tolerance, need for autonomy, locus of control) (Brandstätter, 2011). If innovations are effective and appropriate for teachers and students, they can affect the performance of both teachers and students (Hofman, Jansen, & Spijkerboer, 2011). According to findings of a study done on the perception of managers, teachers and students about innovation competency of teachers it is found that the performance and improvement of people can not be developed without innovation oriented teachers. (Kasule, et al, 2015).

There are some issues in defining and predicting teachers' perception about innovativeness, this study does indicate that the personality characteristics (if effectively measured) can be used to identify people with high attitudes towards innovation (Vanderlinde & van Braak, 2011). Existing literature indicates that openness to experience is the most powerful predictor of innovation on attitudes and performance in areas other than teaching (Zhao and Seibert, 2006). Conscientiousness and extraversion are other but less powerful predictors in the big five personality model (Brandstätter, 2011). Openness to experience, in parallel with the other studies, emerged to be the most important personality factor among others in our sample of teacher candidates. 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 (Rauch & Frese, 2007; Brandstätter, 2011).

In the present study, among the family variables including family attitude, geographical background and family type, only family attitude turned out to be the only factor predicting innovation perceptions of the teacher candidates. This finding is in line with the evidence in the literature in areas other than teaching on the differential effects of family variables on innovative performance and attitudes (Scott & Bruce, 1994; Mumford, et al., 2002; Quazi, & Talukder, 2011). Family background variables seem to have an indirect influence on innovation perceptions. Their impact is through family processes which in turn influence the home climate (Patterson, Kerrin & Gatto-Roissard, 2009). For instance, individuals raised in families with a stable background and a history of high academic achievement will more likely develop positive attitudes towards innovation in quantitative areas, than those who were not (Simonton, 2008).

We also wished to test the validity of the general public belief that there is a positive relationship between area of expertise and attitudes towards innovation and that the more quantitatively oriented one's area of education is, the more likely one develops positive attitudes towards innovation. Hence we thought, at the outset, that the epistemological differences among areas of teaching would make a difference in the IIS scores. However, 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).

Real life problems used in classrooms share a commonality to those faced in business contexts and that their solutions require innovative approaches. Developing students' twenty-first century skills such as problem solving, innovation, entrepreneurship, technological communication, and investigativeness is an important goal for the teacher education programs (Corlu & Aydin, 2016). Hence teacher candidates need to develop skills of using innovative teaching approaches. This study is an effort to assess the readiness of teacher candidates for the fulfillment of this aim.

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