ISSN 1648-3898

A CROSS-NATIONAL STUDY OF PROSPECTIVE ELEMENTARY AND SCIENCE TEACHERS' CREATIVITY STYLES

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Abstract. *1799 prospective teachers (596 males, 1203 females), enrolled in various departments (elementary school teaching and science teaching) in selected universities in Croatia, Czech Republic, Lithuania, Slovakia, Slovenia and Turkey, answered questionnaire on creativity styles. From the results of present study we can recognize that creativity potential of prospective elementary and science teachers is more on the adaptors' side than on the side of innovators. The differences between prospective teachers, originating from different countries, study tracks and of different genders, even if statistically significant, are small (Cohen's d below 0.2). From the perspective of the teacher educators it can mean that similar methods to enhance creativity can be used.*

Key words: *creativity styles, prospective elementary teachers, prospective science teachers.*

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Introduction

The world we are living in is overpopulated with problems on a global (e.g. global warming, population growth, depletion of resources, loss of biodiversity), large, small or individual scale where knowledge about problems can be only a first step toward solving them. Development of science and scientific literacy (DeBoer 2000; Millar 2006) as a capacity to recognize and understand such problems is not sufficient. What we need in addition is to arm citizens to create and evaluate solutions. If started with Albert Einstein's quotation that " The significant problems we face cannot be solved at the same level of thinking we used when we created them" (Calaprice 2000), then the only way is to adapt existing or to find novel solutions. Every society or entrepreneurship which wants to solve problems, create new products or invent new processes need a surplus of creative people who are going to think and work creatively (Florida 2004) and develop a culture of innovation and creativity (Dobrowolska 2010).

The term creativity defied precise definition and there exists a plethora of different theories and definitions ranging from a view that creativity as a process does not exist at one end (Weisberg 1999) to recognition of different kinds of creativities at the other end (Kirton 1976; Sternberg 2005; McWilliam and Dawson, 2008). Additionally, connections between school or job performance, knowledge, intelligence(s), inherited abilities and creativities are

far from straightforward (e.g. Simonton 1999a, b; Weisberg 1999; Preckel, Holling, and Wiese 2005; Demetriou, Spanoudis, and Mouyi 2011).

Creativity in schools is traditionally connected with subjects such as art or literature but rarely with science subjects or mathematics (Newton and Newton 2010). On the other hand, successful societies cannot prosper only on creative artists or writers. Society also needs creative scientists, physicists, economists and engineers who will be able to find solutions to local and global problems such as improving the efficiency of usage of energy and material sources, finding new methods of health care, improving yield, managing waste, activating of local resources and human potential, to mention only a few. Even if one is not going to use creativity as an employee, creativity can help in solving home or personal problems or simply add methods and instruments for better understanding the world and surrounding phenomena.

It cannot be expected that a shift toward creativity and innovation will be welcomed in schools and there exists a discrepancy between key documents encouraging creativity and school practice (Craft, 2003). The main reason is that inventors need to think differently in order to break existing paradigms (Chen and Guan 2010), a fact that is not in line with conservative teaching practices and established cultures of assessment in schools. Sahlberg and Oldroyd (2010) recognize that the bureaucratic 'industrial', standards-driven model of schooling currently fails to release the talents of students for either the competitiveness or the collaboration that will be crucial in facing the demands of the decades ahead. Yet, it would be unfair to say that creativity does not already have its place in schools. One can easily identify many activities which can be regarded as creative at every school, ranging from art and theatre groups to young researchers or work with gifted children. The problem is that such activities are mostly performed as extracurricular activities or projects, and not all students take part. The intention should be that teaching in all subjects, not only in those regarded as creative, should have at least some components that will lead students toward innovation and creativity.

Regardless of different views on the nature of creativity, it is accepted that all people are creative at some level (Stum 2009) and that creativity can be nurtured (Villalba 2010). Development of creativity can and should be a part of teaching in schools and key factor in these processes are teachers. As stated by Kampylis, Berki, and Saariluoma (2009) that 'Teachers play a crucial role in the development of primary school students creative potential in either a positive or a negative way." Sternberg (2005) says that 'The most powerful way to develop creativity in your students is to be a role model. Children develop creativity not when you tell them to, but when you show them".

Teacher education programmes should develop three domains of competences regarding creativity. The first one is to help upbringing prospective teachers' own creativity potentials to the higher level; the second one is to provide them with strategies, how to raise individual creativity in their students; and the third, how to manage classroom creative work.

As an informal international group of science teacher educators we are well aware that science teaching in Croatia, Lithuania, Czech Republic, Slovakia, Slovenia and Turkey is predominately content oriented (Šorgo et. al, 2011) and that changes are necessary. One of the prerequisites to start with changes in teacher education at our institutions is recognition of the properties of the population of the prospective science and elementary teachers. In the summer semester of 2010/2011 a large study on personal characteristic was conducted. One of the partial goals of the study was to find creativity potential of our students. Measuring creativity potential is not an easy task and several hundreds of different instruments exist basically measuring creative products, the creative process, motivation, and personality/ability (Cropley, 2000). Another distinction should be made between identification of some particular creativity style or talent and measurement of its creativity level. On the other hand results from measuring one aspect of creativity cannot be straightforwardly transferred to some other aspect, even if some general patterns can be recognized such as correlations between creativity and different aspects of intelligence and giftedness (Jau ovec, 2000, Elisondo &Donolo, 2010, Kaufman, Plucker, & Russel, 2012). Isaksen & Puccio (1988) showed a correlation between creativity style measured by Adaption-Innovation (KAI) inventory (Kirton, 1976) and creativity level identified by Torrance Test of Creative Thinking (Torrance, 1974 in Isaksen & Puccio,1988). Because of complex nature of creativity/creativities the best approach would be use of battery of tests (Kaufman, Plucker, & Russel, 2012) what is in most practical cases hard to achieve.

The purpose of this part of the study was to find prevalent creativity styles (Kirton 1976; Ee, Seng, and Kwang, 2007) of the prospective elementary and science teachers. Simplified version (Shara, online) of the KAI inventory (Kirton, 1976) was used. It is worth mentioning that KAI measures style and not level. The difference is that level is a measure of capacity and style is a measure of approach. According to Cropley (2000, p. 76) "This test distinguishes between people who seek to solve problems by making use of what they already know and can (adaptors), and people who try to reorganize and restructure problem (innovators)." The rationale for choosing this instrument was that the instrument is designed for self-assessment and due to the format, mistakes in data acquisition in an international study are minimized.

Methodology of Research

Sample

Sample consisted of 1799 prospective teachers (596 males, 1203 females) enrolled in various departments (elementary school teaching and science teaching) of faculty of education in selected universities in Croatia, Czech Republic, Lithuania, Slovakia, Slovenia and Turkey. Participation was voluntary-based and anonymity of the participants was guaranteed. The distribution of the participants across to the countries are as follows; Croatia 165 (9.2%, Czech Republic 458 (25.5%), Lithuania 427 (23.7%), Slovakia 103 (5.7%), Slovenia 310 (17.2%), and Turkey 336 (18.7%). Of the participants, 962 (53.5%) are elementary school teachers and 837 (46.5%) science teachers. The ratio between elementary teachers and science teachers differs between countries: e.g. Croatia 127 (77.0%): 38 (23.0%); Czech Republic 267 (58.3 %): 191 (41.7%), Lithuania 180 (42.2%): 247 (57.8%); Slovakia, only prospective science teachers were in sample 103 (5.7%), Slovenia 143 (45.1%): 167 (53.9%), and Turkey 245 (72.9%): 91 (27.1%).

Data Collection Instrument

To answer research question concerning creativity style simplified Adaptor Innovator Scale based on the KAI inventory (Kirton 1976) was used. The questionnaire developed by James H. Shara (Adaptor Innovator Scale) was translated into the Croatian, Czech, Lithuanian, Slovakian, Slovenian and Turkish languages by the ones who knew both languages very well (e.g. English-Turkish, English-Slovenian). The authors are well aware that due to the translation, unidentified differences may exist between the questionnaires, which could be taken as a weakness of the study.

The questionnaire with 10 items on a five point Likert type scale (Table 1) was administrated to the participants in the summer semester of 2010 – 2011 academic year. Participants were provided with instruction; 'If one of the descriptions matches you very closely, choose 1 for the description on the left or 5 for the one on the right. If you learn one way or the other, choose 2 or 4, or if you are a blend of the two characteristics, choose 3.'

Cronbach's alpha reliability coefficient of the questionnaire was found 0.760, what can be recognized as satisfactory.

Data Analysis

After missing data and outlier analyses, the cleaned data were subjected to normality analysis using the technique of Kolmogorov – Smirnoff test. It was observed that all variables followed normal distribution, what allowed testing differences with parametric tests (t-test and ANOVA). Differences between means in individual items and among the countries were tested by ANOVA and Bonferoni Post hoc test. Separate independent t-test was used to examine the differences in department and gender. Reliability of the questionnaires was tested by using Cronbach's alpha. The effect size was measured using Cohen's d.

Results of Research

From the Appendix 1 it can be recognized that Adapters outnumbered Inventors and that most of the prospective elementary and science teachers recognized themselves as a blend of both styles. On the adaptors side of the scale 34.6% of respondents would try to achieve harmony in a group and almost 31% of teachers want to be seen as practical, safe, and dependable. On the Innovators part of the scale the highest agreement was with the statement 'I prefer to see things change' (17.3%) and 'I like variety in my work' (14.6%).

Table 1. Differences of means among countries on the Adaptor Innovator Scale.

Country	N	Mean	Std. Dev.	Min.	Max.	F	Sig
Croatia (CRO)	165	2.6049	0.62577	1.00	4.30		
Czech Republic (CZ)	458	2.7205	0.67873	1.00	4.80		
Slovenia (SI)	310	2.7720	0.61925	1.00	4.70		
Lithuania (LT)	427	2.8993	0.65762	1.00	4.90	7.306	0.000
Slovakia (SK)	103	2.8612	0.76109	1.20	4.70		
Turkey (TR)	336	2.6826	0.67409	1.20	4.70		
Total	1799	2.7622	0.66906	1.00	4.90		

As presented in Tables 1 and 2, it can be recognized that the majority of pre-service teachers preferred adaptive creativity style in all countries. The differences are statistically significant but not enormous, $F(5, 1799) = 7.306$, $p = 0.000$. Lithuanian pre-service teachers can be recognized as potentially the most innovative and Croatian teachers as the most adaptive.

Table 2. Multiple comparisons of differences between countries on the Adaptor Innovator Scale (Bonferoni post hoc test). Statistically significant differences at the p< 0.05 level are bolded.

	CRO	CZ	SI	LT	SK
CZ	-				
SI	-	-			
LT	* CRO < LT	* CZ<LT	-		
SK	* CRO < SK	-	-	-	
TR	-	-	-	* TR<LT	-

NS: Not significant

**The mean difference is significant at the 0.05 level.*

Post hoc analysis was employed to examine the pairwise comparisons. Table 2 was designed as a result of Post hoc analysis using Bonferoni technique undertaken subsequent to ANOVA analysis. As presented in Table 2, this post hoc analysis revealed that prospective teachers in Lithuania scored significantly higher than those in Croatia (CRO), Czech Republic (CZ) and Turkey (TR). Similarly, the prospective teachers in Slovakia (SK) scored significantly higher than those in Croatia (CRO). Other comparisons were found to be statistically insignificant at the 0.05 level.

Independent sample t-test was performed in order to examine the gender differences in terms of total score of creativity. The test resulted in statistically significant difference in favour of male students, but the effect size was small, $t(1797) = 3,44$, $p<0.001$, Cohen's $d=0.17$). Both groups of students fell in the adapter type of creativity style. But, male students ($M=2.84$, $SD=0.66$) more inclined to innovator

type than female ones (M=2.72, SD=0.67). Furthermore, independent sample t-test was also performed to investigate the differences between students in elementary education program and science education program. The result was found statistically significant [t (1798) = 3.37, p<0.001, Cohen's d = 0.16] meaning that students in science education program (M=2.82, SD=0.67) scored higher than those in elementary education program (M=2.71, SD=0.66) even though both groups of students fell in the adapter type of creativity style.

Discussion

From the results of present study we can recognize that creativity potential of prospective elementary and science teachers is more on the adaptors' side than on the side of innovators. Ee, Seng, and Kwang (2007, p. 370) recognized that "In examining the relationship between creativity, risk orientations, achievement goals, and personality traits innovators scored significantly higher in creativity, risk taking, mastery goal, extraversion and openness to experience compared to their adaptors. However, adaptors scored significantly higher on risk avoidance, ego approach, ego approach goal and conscientiousness.", and "The findings of this research suggest that to nurture creative, compassionate, and vivacious learners who are infused with the joy of learning, educators should cultivate learning environments which facilitate task-involvement and inhibit ego-involvement in students.", what is much easier to be achieved with innovators than with adaptors.

The differences between prospective teachers originating from different countries, study tracks and of different genders, even if statistically significant, are small (Cohen's d below 0.2). Reasons of differences between countries and study tracks cannot be explained by the design of the present study and need further elaboration. Most probably they are a consequence of differences in teaching beliefs based on their previous experiences, differences in teaching cultures and general openness to creativity of the society (Lin, 2011; Wang, 2011).

From the perspective of the teacher educators it can mean that similar methods to enhance creativity can be used. Such methods and strategies to enhance small 'c' creativity, like problem-based and inquiry teaching, are not unknown (Craft, 2003; Jang 2009; DeHaan 2009; Laius & Rannikmaee, 2011), but the problem is that they are rarely used in teaching practice (Meintjes & Grosser 2010; Šorgo et al. 2011, Šorgo &, Kocijančič, 2011). The finding can be partially explained by prevalent adapting creativity style. Adaptors tend to improve things rather to change them (Kirton 1976). If we choose laboratory manuals as an example, adaptors are going to perfect expository manuals to get results with minimal error. On the other end of the continuum innovators may search for multiple approaches to reach intended outcomes.

Adaptors are probably better suited to teach in contemporary school systems which are mostly rigid in structure and outcome oriented with well defined goals measured nationally or internationally (e.g. PISA, TIMSS) (Craft, 2003; Ee, Seng, and Kwang, 2007; Šorgo, 2012). If the goal of the school system is to up-bring a student to the highest competency level (s) he can achieve, than we can recognize this as well defined problem (Jau ovec, 2000) and in opposition with the will to introduce creativity into schools (Craft, 2003). In this case agreement with a statement "In change process, I help to maintain stability and order" guarantees stability of the curriculum and success in well defined educational goals and allowing creativity in schools a place in art classes or out of school activities. Similarly we can recognize agreement with the statement "I try to achieve harmony in a group"as a guaranty for continuation of non-conflict and on transmission based teaching practice at least in two of the participating countries (Šorgo et al. 2011). Similarly agreement with the statement "I want to be seen as practical, safe, and dependable" is guaranty of reproduction of traditional teaching styles. As was already recognized (Craft, 2003; Lin, 2011) we must distinguish between creative teaching and teaching for creativity. While adaptors are better suited for creative teaching as a toolbox for better presenting curricular materials, inventors are probably better choice for teaching for creativity. From the perspective of an elementary or secondary school student, the worse situation can be if she/he is not exposed to strategies and methods to raise the level of creativity than to be exposed to the different styles of creativity.

Knowing that creativity style is stable and cannot be changed easily it can be better approach to

prepare activities which are going to raise levels of creative potentials of the elementary and secondary school students rather than to hope that teachers are going to develop such activities themselves. At teacher education institution we should work on two tracks. The first is to teach all prospective teachers how to use 'parboiled' methods which can raise creativity regardless of their creativity style and encourage creative individuals to test their ideas. Additionally, creativity cannot be taught without good knowledge base, as recognized by Sweller (2009, p. 16)" Knowledge base is a requirement for creativity, and it is notable that few if any people demonstrate creativity without first spending long periods of time developing an appropriate knowledge base."

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Appendix 1: Responses on the Adaptor Innovator Scale considering the alternative characteristics for the total sample of prospective teachers (N = 1799).

		Where are you on a scale between these alternatives? 1 2 3 4 5							
Adapters	N	1	2	3	4	5	M	SD	**Innovators**
I want to be seen as practical, safe, and dependable.	1788	554 30.9	378 21.1	545 30.5	172 9.6	139 7.8	2.42	1.146	I want to be seen as an out of the box thinker.
I solve problems by improving what we have.	1791	171 9.5	354 19.8	639 35.7	394 22.0	233 13.0	3,09	1,146	I solve problems by trying out new approaches.
I seek solutions in tried and understood ways.	1795	233 13.0	437 24.3	604 33.6	361 20.1	160 8.9	2,88	1.143	I question assumptions and look for new solutions
I focus on details and reality—what is.	1788	263 14.7	378 21.1	581 32.5	376 21.1	190 10.6	2,92	1,195	I focus on the big picture and possibilities—what might be.
I rarely challenge rules.	1793	456 25.4	554 30.9	497 27.7	203 11.3	83 4.6	2,39	1,118	I have little respect for rules.
I prefer to keep things as they are.	1791	192 10.7	285 15.9	594 33.2	410 22.9	310 17.3	3,20	1,212	I prefer to see things change.
I try to make what we have better.	1793	199 11.1	381 21.2	622 34.7	383 21.4	208 11.6	3,01	1.155	I try to introduce new ideas or approaches.
I am focused and thorough in my work.	1794	337 18.8	320 17.8	555 30.9	320 17.8	262 14.6	2,9[illegible]	1,299	I like variety in my work
I try to achieve harmony in a group.	1795	621 34.6	598 27.7	453 26.2	155 8.6	68 3.8	2,19	1,117	I try to shake things up in a group.
In change process, I help to maintain stability and order	1794	362 20.2	459 25.6	601 33.5	254 14.2	118 6.6	2,61	1,149	In change process, I provide the impetus for change
Total	17922	3388 18.83	4144 23.03	5691 31.6	3028 16.83	1771 9.84	2,76	0.669	

Received: *May 15, 2012* Accepted: *August 20, 2012*

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