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PERSONALITY TRAITS, GOAL ORIENTATIONS AND LEARNING STRATEGIES

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Abstract

Learning strategies are defined as every behaviour or opinion that facilitates information coding in a way that increases their integration and finding. The research have pointed that using learning strategies has positive effects on learning and academic achievement, but many students do not use them. This could be attributed either to the lack of knowledge about the learning strategies: which strategies exist, how and when to use them or to different motivational factors. Some research show that using different strategies can be anticipated based on the personality traits. In this research, we tested the relationship model between personality traits, learning strategies and physics grades. It has been shown that conscientiousness, agreeableness and openness significantly predict educational outcomes, while metacognitive control cycle and surface processing significantly predict physics grades. The obtained results in this research indicate the need to encourage specific learning strategies with students which will increase understanding the material and at the end which will result with better grades.

Keywords: personality traits, metacognitive control, deep processing, surface processing, physics, grammar school students

Introduction

Oxford (1990) defines learning strategies as operations that students use to facilitate acquisition, storage or remembering information, respectively as specific actions that students take in order to make the learning process easier, faster, more effective, fun, controllable and transferable. Learning strategies are any behaviour or thinking that facilitates information coding in a way that increases their integration and contrivance (Weinstein, 1988; according to Vizek Vidović, Vlahović-Štetić, Rijavec and Miljković, 2003). The research has shown that using learning strategies has positive effects on learning and academic achievement; however, many students do not use learning strategies which can be attributed to the lack of knowledge about the learning strategies or on how or when to use the them, or the lack of motivational

factors (Jakšić and Vizek Vidović, 2008). There are significant differences in conceptualization and taxonomy of learning strategies that result from two different directions in learning process resreaching. According to the first approach, we can differentiate cognitive and metacognitive strategies, so Weinsten and Mayer (1986) suggest three categories of cognitive strategies: repetition, organization and elaboration. Repetition refers to memorising the material by actively pronouncing the stimulus that needs to be remembered. Organization includes extraction of the main idea from the text, underlining the material that has to be learnt and ideas organization. The repetition strategies are not effective in helping students incorporate new information in existing schemes within the long- term memory (Weinstein and Mayer, 1986). The higher aim of education would be to prompt the students to understand the text on a relatively deep, conceptual level, which can be accomplished by using strategies of elaboration and organization (Entwistle and Marton, 1984, according to Lončarić, 2014) that are more useful for integration and connection of the new information with the previously acquired knowledge. Schraw and Moshman (1995) define metacognition as knowledge and regulation of cognitive processes. Metacognitive processes are important because they lead to conceptual changes in learning which enables longer retention of the material and application in a new way (Georghiades, 2000). The second approach to learning strategies takes into consideration the level of processing and effort that students make during acquisition of the new material or skills, as well as intention and commitment to learning (Lončarić, 2014). In that way, we can differentiate deep processing strategies and surface processing strategies (ex. Niemivierta, 1996). Deep processing strategies include the "higher order" strategies such as organization and elaboration, while surface processing strategies include strategies of learning by heart without much deliberation about the material that is being learnt. Gadelrab (2011) quotes the differences between the students that approach learning with deep and surface processing. Students that approach learning with deep processing are intrinsically motivated, personal interested and the purpose of learning is enjoyment, they are actively searching for the meaning in what is being learnt and are connecting the new material with the previously acquired knowledge. Students that approach the learning with surface processing are mostly extrinsically motivated, they are trying to avoid failure by learning; they remember and reproduce the material without connecting the material or searching for the meaning of what is being learnt. Lončarić (2014) combines the two approaches and suggests three types of learning strategies: 1. Metacognitive cycle that includes repetition and training and controlling the learning course and outcome, 2. Deep processing that includes: elaboration, organization, application and critical thinking, 3. Surface processing: memorising and focusing on minimal requirements. In view of the learning outcomes, research has shown that the deep processing will most likely lead to conceptual understanding and retaining of the material unlike the surface processing (Entwistle and Ramsden, 1983; according to Lončarić, 2014). This approach has proven to be positively connected to higher grades, higher IQ (Rosander and Backstorm, 2012) and long-term success (Zeegers, 2001). Chamorro- Premuzic and Furnham (2008) point to significant positive correlation between deep processing approach and exam grades. Surface learning strategies will likely lead to lesser quality in all learning outcomes (Marton and Saljo, 1976). Diseth and Martinsen (2003) suggest that the surface learning approach is a negative predictor of the academic success. The research has shown that using only learning by heart generates incorrect conclusions and comprehension of scientific concepts (BouJaoude, 1992). One study has indicated that deep processing is connected to material comprehension while learning by heart is connected to more incorrect conclusions about Newton's physics (Williams and Cavallo, 1995; according to Cavallo et al., 2003).

Personality is an individual set of behaviour, opinion and emotion that marks individual's life adjustment (Rathus, 2000). Currently the most actual personal traits model is the Big Five

Model (Costa and McCrae, 1992) that encompasses five personality characteristics which are neuroticism/emotional stability, extraversion, conscientiousness, agreeableness and openness. Many research correlate personal traits and variables connected to school/academic achievement (ex. Bratko, Chamorro-Premuzic and Saks; 2006, Furnham and Chamorro-Premuzic, 2004; Komarraju and Karau, 2005; Komarraju, Karau and Schmeck, 2005; Matešić, jr. and Zarevski, 2008; Poropat, 2009). Conscientiousness, which is characterised by responsibility, organization and persistence, is most often connected to positive work and education outcomes (Furnham and Chamorro-Premuzic, 2004). Poropat (2009) has conducted a meta-analysis of the articles that dealt with predicting academic achievement on the basis of personality traits in elementary school, grammar school and college. The sample included more than 70 thousand participants. Meta-analyses showed that conscientiousness has the leading role in predicting academic success in regard to other personality traits, as well as that the role of consciousness does not decreases as the level of education increases, albeit its role increases when the role of intelligence is controlled. The research of Hakimi, Hejazi and Lavasani (2011) on 1050 students has indicated that personality traits predict up to 48% of the academic success, of which 39% is predicted by conscientiousness. On the Croatian sample of grammar school students conscientiousness has proved to be the best predictor of academic success in relation to intelligence and other personality traits (Bratko, Chamorro-Premuzic, Saks, 2006; Matešić, jr. and Zarevski, 2008). In the Bratko et al. (2006) research personality traits were measured with a self-evaluation questionnaire, and were evaluated by their peers. Conscientiousness was proven to be the best academic success indicator in the case of self-evaluation and also in the case of the peers' evaluation. Conscientiousness is connected to using self-regulating learning strategies; conscientious students learn more and are better in organizing their time (Bidjerano and Dai, 2007). Bidjerano and Dai (2007) found positive correlation between conscientiousness and cognitive strategies of higher order (deep processing) such as elaboration, critical thinking and metacognition, and average grades. People positioned high on the neuroticism scales are characterized by anxiety, uneasiness, depression, anger and insecurity (McCrae and Costa, 1992). These characteristics can interfere with cognitive processes such as working memory (Matthews et al., 2000; according to Furnham and Chamorro-Premuzic, 2004) which would result in negative educational outcomes. Neuroticism is connected with significant anxiety during stressful situations such as college exams or with avoiding test situations (Furnham and Chamorro-Premuzic, 2004). Sorić (2014) suggest that more neurotic students demonstrate lower level of self-efficiency, choose less effective dealing strategies and are more likely to give up, which also contributes to worse academic achievement. Neuroticism is connected to worse cognitive skills and lack of critical thinking, analytical skills and conceptual comprehension which happens as a result of a higher cognitive functions blockade in stressful situations (Bidjerano and Dai, 2007). Neuroticism is associated with surface learning strategies and learning by heart and focusing on the surface features of the material being learnt (Entwistle, 1988; according to Bidjerano and Dai, 2007). However, when speaking of neuroticism and educational outcomes, the results are not completely consistent. Bratko, Chamorro-Premuzic and Saks (2006) and Komaraju et al. (2009) research have indicated positive effects of neuroticism on academic achievement. These findings can be explained with high level of preoccupation and perfectionism that lead to better preparedness and better execution with neurotic students. Extraversion is characterised by assertiveness, socialness, talkativeness and optimism that can be associated with positive, but also negative educational outcomes. Namely, inclination to leadership and forcefulness of extraverted students will most likely have a positive effect on academic achievement, while the desire for socializing and inclusion in various activities (that are not connected to learning) will have a negative effect on academic achievement (Poropat, 2009). In Croatian sample of grammar school students extraversion negatively correlated with

the average school grades (Bratko, Chamorro-Premuzic, Saks, 2006, Matešić, jr. and Zarevski, 2008). Also, some researches indicated that extraverts are better elementary school students, and that introverts are better grammar school and college students (Entwistle, 1972, according to Vizek Vidović et al., 2003) which is explained by bigger emphasis on group work and social activities in elementary school, unlike latter learning which is based on individual work. Considering that the research results dealt with relationship between extraversion and academic success, similar results emerged in researching extraversion and learning strategies. Bidjerano and Daia (2007) research indicated positive correlation between extraversion and help seeking strategy, which means that extraverted students, characterised by assertiveness and talkativeness, will more often ask a professor or a colleague for help. Chamorro-Premuzic and Furnham (2009) suggest that extraversion in most often connected to deep approach learning that is characterised by intrinsic motivation, personal interest and learning as a pleasure and strategic approach that is characterised by focus on achieving success and good grades. However, in the research itself Chamorro-Premuzic and Furnham (2009) did not confirm the connection between extraversion and learning approach, while the Rosander and Bäckström (2012) research indicated positive correlation between extraversion and surface approach learning. It is characterised by extrinsic motivation, learning to avoid failure, remembering and reproduction of material without connection with previously acquired knowledge, or without looking for meaning in what is being learnt. Openness refers to creativity or thinking divergence, flexibility and tendency for creating new ideas (Erdheim, 2007). With conscientiousness, openness is most frequently connected to academic achievement. Meta-analysis (Poropat, 2009) has indicated significant correlation between openness and academic achievement, even though it is not as strong as the correlation between conscientiousness and academic achievement. Bidjerano and Dai (2007) relate openness and "higher order" learning strategies such as metacognition, elaboration and critical thinking. Openness is positively correlated to deep approach learning (Chamorro-Premuzic and Furnham, 2008, Chamorro-Premuzic and Furnham, 2009, Rosander and Bäckström, 2012), and negatively to surface approach learning (Chamorro-Premuzic and Furnham, 2009, Rosander and Bäckström, 2012). In Chamorro-Premuzic and Furnham (2009) research, openness has proven to be the only significant predictor of learning approaches. Agreeableness refers to altruism, care and emotional support. Because of their personality traits, students that achieve higher results on agreeableness scales are particularly successful in tasks that require cooperation and group work. Poropat (2009) suggests positive correlation between agreeableness and academic achievement; however, that correlation weakens as the level of education rises. The decrease in the intensity of correlation between agreeableness and academic achievement can be explained with higher emphasis on cooperation and group work on lower levels of education, in comparison to the individual work on higher levels of education. Bidjerano and Dai (2007) found connection between agreeableness and time management and effort regulation strategies. Rosander and Bäckström (2012) found positive correlation between agreeableness and deep approach to learning and negative correlation between agreeableness and surface approach. Chamoro-Premuzic and Furnham (2009) suggest positive relation between agreeableness and "higher order" strategies since the students that score high on the agreeableness scale, are lenient and cooperative and hence can regulate their learning accordingly with situation requirements.

Physics is a natural science that deals with fundamental behaviour laws of material world from the smallest particles to space flocks (Sliško, 2004). Based on these laws it is possible, at least roughly, to scientifically contemplate about the beginnings of the universe and how it would, eventually, end. It is clear, also, that the physics knowledge secured immense technological progress, from the discovery of electricity to inventions such as television, mobile phone etc. Looking at physics like this, awakens interest with most people sometimes

ponder how did the world appear or will the world end and when. From aforementioned, it could be concluded that physics is extremely interesting subject for the majority of students and that they would gladly choose schools and colleges where physics is one of the most important subjects. However, this was proven to be incorrect, students frequently consider physics as hard and uninteresting (Marušić, 2006) and they try, if possible, to avoid it in their further education.

The aim of the research was to examine relation between personality traits, learning strategies and physics grades. Taking into consideration previous research, the assumed model was set:

H1: positive correlation is expected between conscientiousness and deep cognitive processing, metacognitive strategies and physics grades. Negative correlation is expected between conscientiousness and surface cognitive processing.

H2: positive correlation is expected between openness and deep cognitive processing, metacognition and grades. Withal, negative correlation is expected between openness and surface cognitive processing.

H3: positive, but weak correlation is expected between agreeableness and extraversion and deep cognitive processing, metacognitive strategies and physics grades.

H4: negative correlation is expected between neuroticism and deep cognitive processing, metacognitive strategies and physics grades. In addition, positive correlation is expected between neuroticism and surface cognitive processing.

H5: it is expected that deep processing and metacognitive control will be positive predictors of grades, while surface processing will be negative predictor of grades.

H6: it is expected that learning strategies will have a mediating role in relationship between personality traits and grades.

Table 1. Display of expected correlation between personality traits, learning strategies and grades

	Metacognitive control	**Deep processing**	**Surface processing**	**Grade**
Conscientiousness	+	+	-	+
Agreeableness	+	+	-	+
Extraversion	+	+	-	+
Openness	+	+	-	+
Neuroticism	-	-	+	-

Method

Participants

The participants were 645 students from second and third grade of grammar school (general orientation) from five schools from Osijek Baranja county and Vukovar Srijem county. 227 boys and 418 participated in the research, 322 were second grade students and 323 were third grade students. The average age of the participants was 16.62 (SD=0.62). The research

included grammar schools of general orientation from different size towns in order to reduce school characteristics interference (Osijek, Vukovar, Županja, Valpovo and Beli Manastir).

Instruments

BFI (Big Five Inventory; Benet-Martinez and John, 1998) – consists of 44 items, and was constructed to effectively and quickly measure dimensions of the five- factor model (extraversion, neuroticism, conscientiousness, agreeableness and openness).Coefficients of internal consistency (Cronbach α) obtained in this researchvary from 0.71 to 0.81. Examinees are evaluated on 5 degrees Likert scale type (1- I completely disagree; 5- I completely agree).

Customized Learning Strategy Scale (Lončarić, 2014) - consists of three components

1) Metacognitive learning control cycle (Repetition and practising, Learning course and outcome control)- 11 items
2) Deep cognitive processing (Elaboration, Organization, Application, Critical thinking)- 20 items
3) Surface cognitive processing (Memorising, Focusing on minimal demands)- 8 items

Scale reliability (Cronbach α) in this research varies from .85 to .90. Participants estimate on a 5- point scale to which measure they use learning strategies specified in specific claims (1- I have never done it like that; 5- I always do it like that. Items are customized in order for students to focus on their behaviour while learning physics.

Grades – last year year's final physics grade

Procedure

The research was conducted during physics classes or other subject classes. Students were asked to participate in the research and were told that the participation is voluntary. Also, they were asked to provide honest answers since the individual results and the class' results will only be accessible to the head researcher, and only the overall group results (from 645 examinees) will be available for public. Students were informed that they would be acquainted with the key research results after completion of the research. First, the data about the age and gender and last year's final physics grade was collected, then they filled out the Personality Questionnaire and the Learning Strategies Questionnaire. Students were motivated to participate in the research by providing them with the possibility of a feedback (that will be accessible only to them) about their individual results after completing the research.

Statistical programs SPSS 19 and AMOS18 were used for data analyses.

Results

Table 1. and Table 2. Present arithmetic means, standard deviations, minimum, maximum, skewness and kurtosis, and intercorrelations of all measured variables

Table 1. Arithmetic means, standard deviations, minimum, maximum, skewness and kurtosis of all measured variables

	N	M	SD	Min	Max	Skew	Kurt
E	645	3.55	0.61	1.67	5	-0.24	-0.08
N	645	2.44	0.70	1	4.5	0.42	-0.33
C	645	3.23	0.65	1.25	5	0.06	-0.10
A	645	3.57	0.67	1.38	5	-0.42	-0.16
O	645	3.48	0.59	1.70	5	-0.13	-0.10
Meta	645	37.61	8.81	11	55	-0.38	-0.39
Deep	645	59,44	13.82	20	98	-0.09	-0.10
Sur	645	22.71	7.17	8	40	0.06	-0.66
Grade	645	2.91	0.94	2	5	0.72	-0.48

E - extraversion, *N* - neuroticism, *C* – conscientiousness, *A*– agreeableness, *O* – openness, *Meta* – metacognitive control cycle, *Deep* – deep processing, *Sur* – surface processing, Grade– final grade at the end of the school year,

Table 2. Intercorrelations of all measured variables

	E	N	C	O	A	meta	deep	sur	grade
extraversion	1	-.19**	.15**	.17**	-.01	.07	.01	-.06	.02
neuroticism		1	-.23**	-.11**	-.16**	.00	-.05	.05	.04
conscientious			1	.19**	.29**	.27**	.23**	-.21**	.25**
openness				1	.09*	.19**	.29**	-.18**	.08*
agreeableness					1	.19**	.11**	-.05	-.01
meta						1	.63**	-.31**	.30**
deep							1	-.35**	.25**
surface								1	-.50**
grade									1

*p> 0.05; **p>0.01

Results presented in the *Table 1.* indicate satisfactory reliability of all measured variables. *Table 2.* represents correlations between variables and it can be noticed that correlations vary from slight to moderate. From the correlation matrix, it can be noticed that extraversion and neuroticism are not significantly connected to learning strategies and grades. This finding is a bit unexpected and will be further investigated in *the Discussion.*

Path analyses will be used for hypothesis evaluation. Path analysis enables the researcher simultaneous evaluation of the complex connections (direct and indirect) between certain variable relationships. This analysis is a methodical tool that helps, based on quantitative correlation data, to disentangle the various processes underlying a particular outcome (Lleras,

2005). The model, based on the research hypothesis, assumes that personality traits will significantly predict learning strategies and grades and that learning strategies will significantly predict grades as well as that the learning strategies will be a mediator between the personality traits and grades.

Table 2. indicates that extraversion and neuroticism are not significantly correlated to learning strategies and grades. In addition, when we test the model that consists of the five personality traits (Model 1), model indicators are not satisfactory. For that reason, the model that consists of three personality traits (Model 2): conscientiousness, agreeableness and openness will be tested.

Table 3. Accordance and comparison indicators of various implied models

Model	χ^2	df	CFI	NFI	RMSEA	GFI	SRMR
Model 1	27.5**	4	.975	.971	.095	0.99	.037
Model 2	**4.7***	**1**	**.995**	**.994**	**.076**	**0.998**	**.002**

Model indicators demonstrate good model compliance when the three personality traits are added; hence, the results will further be interpreted in the context of that model.

Table 4. Extent and significance of personality traits effect on learning strategies and physics grade

predictor		**criterion**	**β**
conscientiousness	→	metacognitive control	**0.20****
conscientiousness	→	deep processing	**0.17****
conscientiousness	→	surface processing	**-0.18****
conscientiousness	→	grades	**0.16****
agreeableness	→	metacognitive control	**0.12***
agreeableness	→	deep processing	0.04
agreeableness	→	surface processing	0.02
agreeableness	→	grades	**-0.09****
openness	→	metacognitive control	**0.14****
openness	→	deep processing	**0.26****
openness	→	surface processing	**-0.15****
openness	→	grades	-0.05

**p<0.01; *p<0.05

Result show that conscientiousness has a significantly positive effect on metacognitive control, deep processing and grades, and significantly negative effect on surface processing. Agreeableness has a significantly positive effect on metacognitive control and significantly negative effect on grades. Openness has a significantly positive effect on metacognitive control and deep processing, and negative effect on surface processing. Openness has no significant effect on physics grades.

Table 5. Extent and significance of learning strategies effect on physics grades

predictor		criterion	β
metacognitive control	→	grades	**0.17****
deep processing	→	grades	-0.02
surface processing	→	grades	**-0.44****

**p< 0.01

As seen in *Table 5*. metacognitive control has a significantly positive effect on grades while surface processing has a significantly negative effect. Deep processing has no significant effect on grades.

Personality traits explain 10% of metacognitive control variance, 11% of deep processing and 6% of surface processing, while personality traits and learning strategies together explain 30% of physics grades variance.

Table 6. Testing learning strategies mediating role in relation to personality traits and physics grades

predictor		criterion	β
conscientiousness	→	grades	**0.11****
agreeableness	→	grades	0.01
openness	→	grades	**0.08***

**p<0.01; *p<0.05

Conscientiousness and openness have a significant indirect effect on grades; the effects are little but still significant.

Discussion

Results indicate that extraversion and neuroticism are not significant academic outcomes predictors. Even though this finding is a bit unexpected, the literature often contains ambiguous results related to these personality traits and their effect on educational outcomes. Some research has shown that extraverted students perform better in elementary school while introverted students perform better in grammar school, and college (Entwistle, 1972, according to Vizek Vidović et al., 2003), which can be explained by higher emphasise on group work and social activity in elementary school, whereas further education focuses on individual work. It is possible that in our research (second and third grade grammar school) extraversion is not that relevant as it is in the elementary school, but again, neither is the individual work that crucial (which serves the introverts) as in college, therefore this personality trait has no significant effect on educational outcomes. Chamorro-Premuzic and Furnham (2009) suggest that extraversion is most commonly associated with deep learning approach; however, in the research itself Chamorro-Premuzic and Furnham (2009) did not confirm the correlation between extraversion and learning approach. When speaking about neuroticism, anger, fear, uneasiness and depression can interfere with cognitive processes such as working memory (Matthews et al., 2000, according to Furnham and Chamorro-Premuzic, 2004) which will result in negative educational outcomes. However, Bratko, Chamorro-Premuzic and Saks (2006) and Komaraju et al. (2009) revealed positive effects of neuroticism on academic achievement. These findings can be explained by high level of anxiety and perfectionism that lead to better readiness and execution with neurotic students. From above mentioned, we can perceive results inconsistency when it comes to neuroticism and educational outcomes.

Conscientiousness, agreeableness and openness significantly predict educational outcomes in physics classes, but these effects are not extremely high. Conscientiousness significantly predicts metacognitive control, surface processing and physics grades. Conscientiousness is

characterized by responsibility, organization and perseverance and is generally related to positive educational and work outcomes (Furnham and Chamorro-Premuzic, 2004). This personality trait has the most important role in predicting academic achievement in comparison to other personality traits, and it is the only one that does not decrease as the level of education increases (Poropat, 2009). Therefore, it is expected that conscientiousness will be positively correlated with repetition and practice and with learning course and outcome. Negative correlation between learning by heart and satisfying minimal demands (surface processing) is also expected. Finally, conscientious, organized and perseverant students are expected to achieve better success concerning the school grades.

Agreeableness significantly positively predicts metacognitive control (although that effect is fairly weak). Chamoro-Premuzic and Furnham (2009) suggest positive correlation between agreeableness and "higher order" strategies since the students ranked high on the agreeableness scale are compliant and cooperative and can regulate their learning accordingly with the situation demands; therefore, it complies with the expectations. Agreeableness has significantly negative effect on grades. This course was not expected, but if we take look at the Intercorrelation table (*Table 2*.) it is visible that correlation between agreeableness and the final grade is -0.01 and is not significant, β=-0.09 (significant). It is possible that in the used model, because of the sufficiently large number (N=645), this connection was declared significant, and actually it is agreeableness' negligible contribution in explaining physics grades. If we take into consideration the previously conducted research, Poropat (2009) indicates positive correlation between agreeableness and academic achievement, but that correlation weakens as the level of education increases. Many research do not associate agreeableness with grades or test success (Geramian, Mashayekhi and Ninggal, 2012, Chamorro-Premuzic and Furnham, 2003a, Chamorro-Premuzic and Furnham, 2003b), while some older research suggest negative correlation between agreeableness and grades (Paunonen, 1998, Rothstein, Paunonen, Rush and King, 1994). Chamorro-Premuzic and Furnham (2003b) compared the relationship between different personality traits facets and grades. Any of the agreeableness facets did not show significant correlation with grades; however relationships between certain facets such as altruism and caring and test success (although insignificant) had a negative connotation. In Rothstein et al. (1994) research, correlation between average grade and agreeableness is r = -0.19. We can understand partially this relationship if we take into consideration characteristics of students who score high on the agreeableness scale. The question is to which extent compliance and caring will affect physics grade (and in which direction), especially because of the emphasis on individualism and competition in grammar schools and the fore coming mature exams and college enrolment (it should be taken into consideration that our sample consists only of students attending grammar schools general orientation, and not professional direction). Considering that some authors (Elliot and McGregor, 2001; Moller and Elliot, 2006) indicate that competiveness and abilities demonstration compared to other students have a positive effect on grades, which are not characteristics connected to agreeableness. Although we have to be careful when interpreting relationship between agreeableness and grade, considering weak correlation (r=-0.01, β=-0.09), it is obvious that compliance, caring and emotional support are not characteristics that will have a positive effect on physics grades.

Openness is a significantly positive predictor of metacognitive control and deep processing, and negative predictor of surface processing. The obtained results are expected, considering that, with conscientiousness, openness is most commonly associated with academic achievement. Students open to experience characterises curiosity, creativity and flexibility, therefore the connection with metacognitive control and deep strategies such as critical thinking, elaboration, application and organisation is expected. Some previously conducted research associate openness with deep learning approach (Chamorro-Premuzic and Furnham,

2008; Chamorro-Premuzic and Furnham; 2009, Rosander and Bäckström, 2012). In addition, previous research suggest negative correlation between openness and surface learning approach (Chamorro-Premuzic and Furnham, 2009; Rosander and Bäckström, 2012). In Chamorro- Premuzic and Furnham (2009) research, openness is indicated as the only significant learning approach predictor, but not a grade predictor, which is most likely connected to absence of deep processing effect on grades. Possible explanations of absence of deep processing effect on grades will be listed further in the text.

Results show that metacognitive control has a significant effect on physics grades (even though that effect is not particularly strong, $\beta=0.17$, $p<0.05$), deep processing has no effect ($\beta=-0.02$, $p>0.05$) on grades, while surface processing has a significantly negative effect on grades ($\beta=-0.44$, $p<0.05$). Significant effect of metacognitive control on grades is expected. The research conducted by Vrdoljak and Velki (2012) with seventh and eighth grade elementary school students suggest that metacognition correlates with better grades in Croatian language and mathematics and academic achievement. Metacognitive control cycle includes repetition and practice, and tracking the learning course and outcomes. Students that repeat and practice the material being learnt, that track the learning course and expected outcomes, that is, were the used strategies effective, are the students that have better grades. Gerghiades (2000) emphasizes the importance of metacognitive processes since they lead to conceptual learning changes, which enables longer material retention and its new application (these conceptual knowledge changes are particularly important for sciences such as physics). Especially unexpected and troublesome data is the insignificance of the deep processing effect on grades. Hence, using the organization, elaboration, critical thinking and application strategies does not significantly predict the physics grades. Even though this data is unexpected, some previous research shows similar relationship between these variables (ex. Diseth and Martinsen, 2003, Vrdoljak, Kristek, Jakopec and Zarevski, 2014). Senko, Durik and Harackiewicz (2008) explain these findings with the fact that knowledge is often tested through multiple choices tasks that test mostly surface material learning, and not the deep comprehension and critical approach to the material. The same authors suggest that students that have deep learning approach frequently show interest for a specific topic within the material, which they examine into detail, and neglect the other parts of the material or the topic is not of a special interest for the teacher and therefore is not represented in the examination. Still, although the correlation between deep processing approach and grades was not found in the previous research as well, the expectation was that, in the physics classes context, deep processing will significantly predict grades. The research has shown that using only learning by heart generates incorrect reasoning and understanding of scientific concepts (BouJaoude, 1992). One study has shown that deep processing correlates with material comprehension, while learning by heart correlates with larger number of incorrect conclusions about Newton's physics (Williams and Cavallo, 1995, according to Cavallo et al., 2003). However, the majority of students are prone to inserting the numbers into formulas, not understanding the relationship between the used symbols. Greeno (1987) suggest that for solving routine tasks it is necessary to possess procedural knowledge that implies using specific operations for achieving the goal. Tasks that are not considered a routine (Greeno, 1987) require conceptual (functional) knowledge that implies finding new functional connections between concepts. Hence, we can conclude that despite conceptual difficulties, it is possible to solve a great number of routine scientific quantitative tasks. As it often happens, students that have good science grades are very good in acquiring suitable equations for a specific tasks without understanding the reason why that equation is appropriate. This can provide an explanation why the correlation between deep processing and physics grades was not obtained.

Results have shown the mediating role of learning strategies (metacognitive control and surface processing) in relation to personality traits (conscientiousness, openness and grades). Therefore, conscientious and reliable students will use more metacognitive control and less surface processing and consequently will have better grades.

The most important conclusions that can be drawn from this research are that the whole model explains 30% of physics grades variance, which is not negligible, and that for better physics grade it is crucial not to use surface learning approach, that is, not to be focused on learning by heart and satisfying the minimal demands. The research has shown that personality traits are significant predictors of educational outcomes (although that effect is not particularly great) and that conscientiousness has a significant effect on all educational outcomes (examined in this research).

When considering the obtained results, some methodological limitations should be taken into consideration. One of the research limitations is using the self-evaluation questionnaire. Self-evaluation questionnaires were used for all measured variables (except for grades). Problem with these kinds of measuring instruments is relying on the examinees ability to self–evaluate their behaviour, opinion and emotions in different situations (personality questionnaire) and way in which they learn physics (learning strategies questionnaire). The other problem is the referent point problem which the examinee takes when evaluating and giving the socially acceptable answers. In that case, the examinee's answer can be influences by his expectations and perception of what others expect of him. One of the path analysis defects is the assumption that the relations between variables are unidirectional, that is, if we assume that learning strategies affect grades, we cannot assume that grades affect learning strategies.

Conclusion

The research results emphasize the need to encourage using metacognitive strategies such as tracking the learning course and outcomes and repetition and practising. It would be useful to stimulate intrinsic motivation with students which would most probably lessen the learning by heart strategies and focus on minimal demands, which, as seen above, have the strongest (negative) effect on grades. In addition, it is recommended to encourage deep processing strategies and using the examination tasks that would test deep processed knowledge, and not only the knowledge learnt by heart and routine insertion of data into equations.

Literature

Bidjerano, T. & Dai, D. Y. (2007). The relationship between the big-five model of personality and self-regulated learning strategies. *Learning and Individual Differences 17*, 69–81.

BouJaoude, S. (1992). The relationship between students' learning strategies and the change in their misunderstandings during a high school chemistry course. *Journal of Research in Science Teaching, 29* (7), 687-699.

Cavallo, A. M. L., Rozman, M., Blickenstaff, J., & Walker, N. (2003). Students' learning approaches, reasoning abilities, motivational goals, and epistemological beliefs indiffering college science cours-es. *Journal of College Science Teaching, 33*(3), 18-23.

Chamorro-Premuzic, T., & Furnham, A. (2009). Mainly Openness: The relationship between the Big Five personality traits and learning approaches. *Learning and Individual Differences, 19,* 524–529.

Chamorro-Premuzic, T., & Furnham, A. (2008). Personality, intelligence and approaches to learning as predictors of academic performance. *Personality and Individual Differences, 14*, 1596–1603.

Chamorro-Premuzic, T., & Furnam, A. (2004). A possible model for understanding the personality–intelligence interface. *British Journal of Psychology, 95*, 249–264.

Chamorro-Premuzic, T., & Furnam, A. (2003a). Personality predicts academic performance: Evidence from two longitudinal university samples. *Journal of Research in Personality, 37*, 319-338.

Chamorro-Premuzic, T., & Furnam, A. (2003b). Personality Traits and Academic Examination Performance. *European Journal of Personality, 17*, 237-250.

Diseth, Å., & Martinsen, Ø. (2003). Approaches to Learning, Cognitive Style, and Motives as Predictors of Academic Achievement. *Educational Psychology, 23*, 195-207.

Elliot, A. J., & McGregor, H. A.(2001). A 2 x 2 Achievement Goal Framework. *Journal of Personality and Social Psychology, 80*(3), 501-519.

Gadelrab, H. F. (2011). Factorial structure and predictive validity of approaches and study skills inventory for students (ASSIST) in Egypt: A confirmatory factor analysis approach. *Electronic Journal of Research in Educational Psychology, 9*, 1197-1218.

Georghiades, P. (2000.). Beyond conceptual change learning in science education: focusing on transfer, durability and metacognition. *Educational Research, 42*, 119-139.

Jakšić, M., & Vizek Vidović, V. (2008). Ciljevi postignuća, percepcija kompetentnosti, spol I strategije učenja u općem akademskom kontekstu. *Suvremena psihologija, 11*(1), 7-24.

Kipins, M., & Hofstein, A. (2008). The Inquiry Labaratory as a source for development of metacognitive skills. *International Journal of Science and Mathematics education., 6*, 601-627.

Koslowski, B. (1969). *Theory and evidence: The development of scientific reasoning*. Cambridge, MA: MIT Press.

Lleras, C. (2005). Path Analysis. *Encyclopedia of Social Measurement, 3*, 25-30.

Lončarić, D. (2014). *Motivacija i strategije samoregulacije učenja: teorija, mjerenje i primjena.* Rijeka: Učiteljski fakultet u Rijeci.

Marton, F. & Säljö, R. (1976). On qualitative differences in learning. I – Outcome and Process. *British Journal of Educational Psychology 46*, 4-11.

Marušić, I. (2006). *Nastavni programi iz perspektive učenika*. In: B. Baranović (Ed.). Nacionalni kurikulum za obvezno obrazovanje u Hrvatskoj – različite perspektive (pp. 175-213). Zagreb: Institut za društvena istraživanja.

Mirzaei, F., Phang, F. A., Sulaiman, S., Kashefi, H., & Ismail, Z. (2012). Mastery Goals, Performance Goals, Students' Beliefs and Academic Success: Metacognition as Mediator. *Procedia - Social and Behavioral Sciences, 46*, 3603–3608.

Moller, A. C., & Elliot, A. J. (2006). The 2 x 2 Achievement Goal Framework. The Owerviev of Empirical Research. *Focus on Educational Psychology*, 307-326.

Niemivirta, M. (1996, March). *Motivational-cognitive components in self-regulated learning.* Paper from 5th International Conference on Motivation, Landau, Germany.

Oxford, R. L. (1990). *Language Learning strategies: What every teacher should know*. Boston: Heinle & Heinle Publishers.

Patrick, H., Ryan, A. M., & Pintrich, P. R. (1999). The differential impact of extrinsic and mastery goal orientations on males' and females' self-regulated learning. *Learning and Individual Differences, 11*, 153-171.

Rosander, P., & Bäckström, M. (2012). The unique contribution of learning approaches to academic performance, after controlling for IQ and personality: Are there gender diffreces? *Learning and Individual Differences, 22*, 820–826

Schraw, G., & Dennison, R. S. (1994). Assessing Metacognitive Awareness. *Contemporary Educational Psychology, 19*, 460-475.

Schraw, G., & Moshman, D. (1995). Metacognitive theories. *Educational Psychology Review, 7*, 351-373.

Sliško, J. (2004). Nastava fizike i kultura razmišljanja. *Časopis za obrazovanje nauku i kulturu 178,* 18-23.

Sorić I. (2014). *Samoregulacija učenja*. Jastrebarsko: Naklada Slap.

Vizek Vidović, V., Rijavec, M., Vlahović-Štetić, V., & Miljković D. (2003). *Psihologija obrazovanja.* Zagreb: IEP-VERN.

Vrdoljak, G., Kristek, M., Jakopec, A., & Zarevski, P. (2014). Provjera modela predviđanja akademskog postignuća studenata: Uloga proaktivnosti i pristupa učenju. *Suvremena psihologija, 2,* 123-134.

Vrdoljak, G., & Velki, T. (2012). Metakognicija i inteligencija kao prediktori školskog uspjeha. *Croatian Journal of Education, 14*(4), 799-815.

Weinstein, C. E., & Mayer, R. E. (1986). The teaching of learning strategies. In: M. Wittrock (Eds.), *Handbook of research on teaching* (pp. 15-327). New York, NY: Macmillan.

Zeegers, P. (2001). Approaches to learning in science: A longitudinal study. *British Journal of Educational Psychology, 71*, 115-132.

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