Big Five personality traits and learning approaches as predictors of achievements in humanities and science subjects

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Abstract

Besides the cognitive factors and intelligence, student performance in learning is also determined by personality traits and learning approaches. The more conscientious, open-minded students, who use deep learning strategies and are performance-oriented achieve higher grade point average (GPA). The purpose of this study is to determine the extent to which performance in humanities and science subjects is predicted and explained by the personality and learning factors we examine. The 154 participants in the research completed the Big Five Personality Inventory, the Learning Process Questionnaire and we used their GPA and their results in sciences (Mathematics, Physics, Chemistry) and humanities (Hungarian, Romanian, English). We have developed three binary logistic regression models to determine the explanatory power of personality traits and learning approaches. The first model is for the science subjects, the second is for humanities, and the third is to explain the GPA.

Keywords

school success, performance in science subjects and humanities, Big Five personality traits, learning approaches, logistic regression model

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Introduction

Cognitive abilities provide only partial explanation for the individual differences in school success (Chamorro-Premuzic & Furnham, 2006), so it is also important to explore non-cognitive factors that may predict school performance. Many researches have used the personality traits measured by the Big Five test as predictors of school success. Personality traits affect certain habits that influence learning, such as perseverance, conscientiousness, verbalism, dominance, and other individual differences. There is a second argument, according to which, cognitive abilities show what an individual can do, while personality traits reflect what the individual will do in a learning situation (Furnham, Chamorro-Premuzic, & McDougall, 2003).

Based on the five-factor model, the main dimensions of personality are neuroticism, extraversion, openness to experience, agreeableness and conscientiousness. These dimensions are at the top level of the personality hierarchy and include the narrower areas of personality traits, which are located at a lower level of the hierarchy (O'Connor & Paunonen, 2007).

The extraversion factor is usually characterized by confidence, free expression of impulses, extraverted individuals are described by dominance, self-confidence and happiness. Commonly, sociability is also seen as part of it, but some researcher consider that it is merely a concomitant of the other characteristics. Agreeableness is nothing more than the ability to maintain relationships, not simply the opposite of emotional inflexibility, in other words it not only covers warmth and geniality, but also includes a kind of obedience, helpfulness, care, emotional support. The dimension of conscientiousness includes planning, persistence and achievement of goals. Conscientiousness is often examined in relation with school performance (O'Connor & Paunonen, 2007), it has been defined as aspiration, will, and responsibility for performance. Concerning neuroticism, emotional instability and subjective anxiety are often highlighted as the main elements. Openness to experience explores the richness of imagination in the Big Five model (Carver & Scheier, 2006).

Conscientiousness positively correlates with the GPA (Noftle & Robins, 2007; O'Connor & Paunonen, 2007; Richardson, Abraham & Bond, 2012), because

conscientious students are more successful and motivated to achieve high grades than the less conscientious ones. Organized, persistent and performance-oriented students perform better in school tasks than their less motivated peers (O'Connor & Paunonen, 2007). More conscientious students are more inclined to planning, they adjust their behavior to their plans, and make efforts to implement these plans (Caprara, Wecchione, Alessandri, Gerbino & Barbaranelli, 2011). Conscientiousness significantly determines the students' performance in Mathematics (Spinath, Freudenthaler & Neubauer, 2010; Steinmayr & Spinath, 2007). This can be explained by the fact that conscientiousness plays an important role in persistent, enthusiastic and continuous learning (Duckworth & Seligman, 2005; Mac Cann, Duckworth & Roberts, 2009).

There is a positive correlation between openness and school performance, which predicts GPA, grades in different subjects and class activity (Furnham & Mitchell, 1991; Heaven, Mak, Barry & Ciarrochi, 2002; Lipnevich, Preckel & Krumm, 2016; Lounsbury, Sundstrom, Loveland & Gibson, 2003). Several studies have shown a positive correlation between openness and mathematical performance (Spinath, Freudenthaler & Neubauer, 2010). Based on the results of the longitudinal study of Heaven and Ciarrochi (2012), there is a significant correlation between openness, conscientiousness and mathematical performance. Openness is closely related to deep learning, which plays an important role in learning Mathematics (Chamorro-Premuzic & Furnham, 2009).

Some studies (Entwistle & Entwistle, 1970; Lipnevich, Preckel & Krumm, 2016) have found a negative correlation between extraversion and GPA. Introverted pupils spend more time with learning, while extraverted children with socialization. Introverted individuals have more positive attitudes towards school than extravert people, who enjoy socializing, they are risk takers, stimulus seekers, dominant, learn less and observe strict rules less than the introverted pupils, who wish to be controlled (Heaven, Mak, Barry & Ciarrochi, 2002).

Many studies show positive correlation between neuroticism and learning performance (Bidjerano & Yun Dai, 2007; Furnham, Chamorro-Premuzic & McDougall, 2003; Komarraju, Karau & Schmeck, 2009; Nguyen, Allen & Fraccastoro, 2005; Rosander, Bäckström) & Sternberg, 2011). Nighute and Sadawarte (2014) in their research found a positive correlation between neuroticism and GPA; based on their

results, openness and neuroticism are considered to be stronger predictors of the GPA than conscientiousness and agreeableness (Nighute & Sadawarte, 2014).

Biggs (1987) distinguished between the motives and strategies used in learning (Furnham, Monsen & Ahmetoglu, 2009). Motives of learning relate to the purpose of their learning, and learning strategies concern to their learning methods (Biggs, 1987). The motives of learning and learning strategies together define learning approaches (Furnham, Monsen & Ahmetoglu, 2009). Biggs (1987) differentiated three main learning approaches: deep, achieving and surface learning. Deep learner's aim is the better and deeper understanding and learning of the curriculum. Achieving learners is to accomplish something, they learn to get rewards, good school results, a prestigious job or cash prizes. Pupils adopting surface learning strategies would like to correspond the minimum requirements (Biggs, 1987).

Performance can be predicted by the learning approach (Duff, 2004; Furnham, 2011; Furnham, Monsen & Ahmetoglu, 2009). Students with deep and achieving learning approaches reach better marks and results, while surface learning leads to lower marks (Chamorro-Premuzic & Furnham, 2008; Duff, 2004; Furnham, Monsen & Ahmetoglu, 2009).

Research Objectives

The main goal of the research is to explore how different learning performances relate to Big Five personality traits and learning approaches. Our further goal is to examine in what extent results obtained in learning are explained by personality factors and learning approaches. From a practical view, it can be determine to what extent the psychological factors we investigate are predictive for school performance, which can also provide the basis for developing an intervention plan.

Hypotheses

1. We hypothesize that the personality traits of conscientiousness, openness and neuroticism are predictors of GPA, performance in humanities and science

subjects, while there is no significant correlation between extraversion, agreeableness and performance.

2. We hypothesize that there is a significant positive correlation between deep and achieving learning approach and GPA, as well as performance in humanities and science subjects; contrary to this, there is a significant negative correlation between surface learning and performance.

3. We hypothesize that openness, conscientiousness and neuroticism, the deep and achieving learning approaches are significant predictors of the GPA, performance in humanities and science subjects, thus contributing to getting higher GPA; we also assume that surface learning approach is a predictor of a low final school performance, and this approach contributes to a decrease in the GPA.

Method and procedure

Participants

Originally, 184 pupils participated in the research, who were Hungarian-speaking high school students in Oradea. The two questionnaires used in the research were completed by all participants. In the course of data processing, the sample was reduced to 154 individuals, including 53 boys and 101 girls, with a minimum age of 15 years, the oldest being 18 years old (Table 1).

Table 1

Participants' age and standard deviation (N=154)

Note. Gender: 1 – male, 2 – female; Age: 1 – 15, 4 – 18

	Min.	**Max.**	*M*	*SD*
Gender	1	2	1.66	.477
Age	1	4	2.25	.940

Instruments

Instruments utilized in the research: The BFI (Big Five Inventory) questionnaire and the LPQ (Learning Process Questionnaire) questionnaire. Participants also completed a questionnaire asking them about their demographic data and school results.

The Big Five Inventory (BFI)

The BFI, Big Five Personality Inventory examines 5 personality dimensions: extraversion, agreeableness, conscientiousness, neuroticism and openness. It contains 44 items that administer scores for the 5 personality factors. Each item can be answered on a 1 to 5 Likert scale: 1 means that the respondent does not agree with the statement at all, 5 means that they fully agree, it is characteristic of them (John & Srivastava, 1999). 8 statements (1, 6R, 11, 16, 21R, 26, 31R, 36) measure extraversion; conscientiousness (3, 8R, 13, 18R, 23R, 28, 33, 38, 43R), agreeableness scores are measured by 9 items (2R, 7, 12R, 17, 22, 27R, 32, 37R, 42); the level of neuroticism is measured by 8 items (4, 9R, 14, 19, 24R, 29, 34R, 39), the level of openness was given by the sum of 10 items (5, 10, 15, 20, 25, 30, 35R, 40, 41R and 44). The questionnaire also contained reverse items (items marked with R) (John & Srivastava, 1999).

Learning Process Questionnaire

LPQ (Learning Process Questionnaire) is a learning process and approach questionnaire consisting of 36 items and was developed by Biggs (1987). Answers given to items serve the scores of 6 sub-scales: surface motive (items 1, 7, 13, 19, 25, 31) and surface strategy (4, 10, 16, 22, 28, 34) deep motive (items 2, 8, 14, 20, 26, 32) and deep strategy (items 5,11, 17, 23, 29, 35), achieving motive (items 3, 9, 15, 21, 27, 33) and achieving strategy (items 6, 12, 18, 24, 30, 36). The scores of learning approaches were calculated from the sum of the motives and strategies of the relevant type (e.g. the score of the surface approach is the sum of the surface motive and surface strategy). Like in the BFI, the answer options ranged from 1 to 5: 1 meaning never, or very rarely true statement for the person, while 5 meant always true (Biggs, 1987).

Research design

In this research, the correlation strategy has been used to identify quantifiable correlations between the personality factors and the learning approaches we have measured. We identified the correlating psychological factors, determined the degree and direction of correlation, but we did not manipulate and control the variables. In this study, 154 persons were involved, single sampling and cross-sectional layout were used (Szokolszky, 2004). After completing the questionnaires, based on the results achieved in humanities and science subjects, and on their GPA, we classified the students into 3 groups: low, medium and high performance groups. We used binary logistic regression analysis to determine the extent to which the personality traits and learning approaches we measured predict GPA and the results obtained in studying humanities and science subjects.

Procedure

The questionnaires were applied in groups, in 9 different classes. The average time necessary to complete the questionnaires was 40 minutes. The participants completed the questionnaires individually; there was no time limit. Participants were told that the questionnaires were to be filled out anonymously and voluntarily. The aim of the first part of the questionnaire was to reveal demographic data: age, grade, gender, place of residence, parents' level of education. Based on personal consent, we have asked for the final grade obtained in the previous semester in Mathematics, Physics, Chemistry, Hungarian, Romanian and English and their previous semester GPA. The students completed the questionnaires in the following order: Demographic data and grades (demographic data: age, gender, grade, mother's and father's education level, place of residence), (grades in: Hungarian, Romanian, English, Mathematics, Physics, Chemistry, semester GPA), Big Five Personality Inventory and Biggs' Learning Process Questionnaire.

Results

In the first step, we checked whether the personality traits and learning approaches we tested were in line with the normal distribution, and whether the Skewness and Kurtosis values were within acceptable limits (Table 1). The mean values and standard deviations are shown in Table 2. Preliminary power analysis (GPower) has shown that 149 students are required to have a strong regression analysis ($\beta = .80$).

Table 2

Mean and Standard Deviation of Big Five Personality Traits and Learning Approaches (N=154)

	M	*SD*	**Skewness**	**Kurtosis**
Extraversion	26.56	6.78	-.53	-.54
Agreeableness	35.15	4.38	-.48	-.02
Conscientiousness	31.68	6.59	-.64	-.11
Neuroticism	23.50	7.37	.08	-1.01
Openness	35.94	6.27	-.45	.007
Surface motive	18.68	4.54	-.32	-.86
Surface strategy	18.45	4.88	-.06	-1.05
Surface approach	37.13	7.10	-.10	-.60
Deep motive	16.30	4.57	.46	-.86
Deep strategy	16.03	4.47	.22	-.39
Deep approach	32.32	7.30	.23	-.42
Achieving motive	15.48	5.61	.36	-.87
Achieving strategy	14.68	5.01	.59	-.59
Achieving approach	30.16	9.19	.35	-.54

Based on the students' average grades, we have created 3 groups: poor performance (up to grade 7), medium performance (between grades 7 to 9), high-level performance (above grade 9). Similarly, we have created 3-3 additional groups after calculating the average grades in science subjects (Mathematics, Physics, Chemistry) and another 3, after calculating the average grades in humanities (Hungarian, English and Romanian): low performers (average grade 4 to 6), medium performers (average grade 6 to 8) high performers (average grade 8 to 10).

Pearson Correlations

We examined the correlations between personality traits, learning approaches, strategies and motives. Considering personality traits, between conscientiousness and GPA (r(154)=.161, p<.05), as well as between conscientiousness and average performance in science subjects (r(154)=184, p<.05) significant, though weak

correlation was found. Similarly, between openness and GPA (r(154)=.253, p<.01) openness and performance in humanities (r(154)=.170, p<.05) and between openness and performance in science subjects, too (r(154)=.263, p<.01), significant, though weak positive correlation was found. Neuroticism correlated significantly only with performance in humanities, yet this correlation can also be considered weak (r(154)=.187, p<.05). Thus, between personality traits and students' results only moderate, weak correlations can be found (Table 3).

Based on Pearson's correlation, we can conclude that there are stronger correlations, relations between learning approaches and performance. Surface learning strategy is in significant negative correlation with both the average grade (r(154)=.-.293, p<.01) and the performance in science subjects (r(154)=-.312, p<.01), as well as performance in humanities (r(154)=-.312, p<.01). Similarly, surface learning approach also correlates negatively with all three dependent variables. Deep learning approach, including deep learning strategy and motive, positively and significantly correlates with all three learning outcomes. The closest correlation can be found between deep learning approach and performance in humanities (r(154)=.335, p<.01), also correlating with the GPA (r(154)=.243, p<.01). We found the strongest correlations, medium-scale interactions between the achieving learning motive, achieving learning approach and the GPA. Between achieving learning motive and the GPA (r(154)=.459, p<.01), and between performance in humanities and achieving motive (r(154)=.419, p<.01), significant, medium strong correlation can be shown. In addition, the average grade correlates significantly with achieving learning approach (r(154)=.429, p<.01), similarly, results in humanities are also positively related to it (r (154) = .484, p <.01) (Table 3).

Table 3

Correlations between personality traits, learning approaches and learning outcomes (N=154)

Note. *p<0.05. **p<0.01.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.Extraversion	-	.129	.339**	.074	.451**	-.022	-.030	-.035	.110	.089	.123	.041	-.012	.018	.021	.084	.028
2.Agreableness	.129	-	.295**	-.229**	.244**	.163*	-.135	.011	.180*	.108	.179*	.113	.191*	.173*	.078	.078	.035
3.Conscientiousness	.339**	.295**	-	.166*	.332**	.006	-.177*	.118	.145	.218**	.225**	.187*	.297**	.276**	.161*	.184*	.079
4.Neuroticism	.074	-.229**	.166*	-	-.033	.024	.036	.040	-.046	-.080	-.078	.034	-.023	.008	.137	.111	.187*
5.Openness	.451**	.244**	.332**	-.033	-	.089	-.122	-.027	.259**	.189*	.278**	.213**	.198*	.238**	.253**	.263**	.170*
6.Surface motive	-.022	.163*	.006	.024	.089	-	.136	.732**	.081	.180*	.161*	.225**	.151	.220**	-.078	-.060	-.054
7.Surface strategy	-.030	-.135	-.177*	.036	-.122	.136	-	.774**	-.096	-.006	-.064	-.160*	-.241**	-.229**	-.293**	-.312**	-.288**
8.Surface approach	-.035	.011	.118	.040	-.027	.732**	.774**	-	-.015	.111	.059	.034	-.069	-.017	-.251**	-.253**	-.232**
9.Deep motive	.110	.180*	.145	-.046	.259**	.081	-.096	-.015	-	.302**	.812**	.343**	.367**	.410**	.190*	.167*	.201*
10.Deep strategy	.089	.108	.218**	-.080	.189*	.180*	-.006	.111	.302**	-	.802**	.401**	.415**	.471**	.203*	.147	.340**
11.Deep approach	.123	.179*	.225**	-.078	.278**	.161*	-.064	.059	.812**	.802**	-	.460**	.484**	.545**	.243**	.194*	.335**
12.Achieving motive	.041	.113	.187*	.034	.213**	.225**	-.160*	.034	.343**	.401**	.460**	-	.494**	.880**	.419**	.357**	.459**
13.Achieving strategy	-.012	.191*	.297**	-.023	.198*	.151	-.241**	-.069	.367**	.415**	.484**	.494**	-	.847**	.317**	.258**	.374**
14.Achieving approach	.018	.173*	.276**	.008	.238**	.220**	-.229**	-.017	.410**	.471**	.545**	.880**	.847**	-	.429**	.359**	.484**
15.GPA	.021	.078	.161*	.137	.253**	-.078	-.293**	-.251**	.190*	.203*	.243**	.419**	.317**	.429**	-	.908**	.833**
16.Science subjects grade point average	.084	.078	.184*	.111	.263**	-.060	-.312**	-.253**	.167*	.147	.194*	.357**	.258**	.359**	.908**	-	.733**
17.Humanities grade point average	.028	.035	.079	.187*	.170*	-.054	-.288**	-.232**	.201*	.340**	.335**	.459**	.374**	.484**	.833**	.733**	-

Regression analysis

After establishing the correlations between personality traits, learning approaches and learning outcomes, we have developed 3 regression models to assess the extent to which different personality traits and learning approaches explain success in studies, GPA, performance in science subjects and humanities and the extent to which they increase or decrease the chances of high academic achievement. A brief summary of the models is presented in Table 4.

Table 4

Summary of binary logistic regression models

Model	Dependent variable	Predictors	Nagelkerke R^2
Model 1	Science subjects grade point average	Openness Surface strategy Achieving approach	.260
Model 2	Humanities grade point average	Neuroticism Openness Surface strategy Deep strategy Achieving approach	.689
Model 3	Grade point average	Conscientiousness Openness Surface strategy Deep approach Achieving approach	.545

In the regression models we included the variables which most strongly and significantly correlated with the results in humanities and science subjects and the GPA. According to the values of Nagelkerke R^2, Model 2 has the greatest explanatory power, according to which the variables introduced into the model explain 68.9% of the results in humanities (Nagelkerke R^2 = .689). Model 3, in which the predictors determining the average grade were examined, also has high explanatory power (Nagelkerke R^2 = .545). Model 1, in which we measured the impact of factors that influence grades obtained in science subjects, has a 26% explanatory power (Nagelkerke R^2 = .260).

Table 5

Model 1: Predictors of performance in science subjects (N=87)

Predictor	*B*	SE	Wald	df	p	Odds Ratio	Chance for increasing/ decreasing	95% C.I.for EXP(B)	
								Lower	Upper
Openness	-.073	.048	2.318	1	.128	.929	7.58	.84	1.02
Surface strategy	.099	.052	3.671	1	.055	1.104	-9.44	.99	1.22
Achieving approach	-.065	.029	5.066	1	.024	.937	6.68	.88	.99
Constant	2.293	2.060	1.239	1	.266	9.904			

Note. Nagelkerke R²=.260; Hosmer and Lemeshow test χ^2 (8) = 4.95, p = .76; CI = Confidence interval

After completing the binary logistic regression analysis, the odds ratio could be used to calculate how a one unit change of the score increases or decreases, affects performance in science subjects. The greatest change in performance in science subjects is determined by surface strategy, reducing the chances of good performance by 9.44% (OR = 1.10, 95% CI = .99 - 1.22). So, if the surface strategy score increases by one unit (point), the grade obtained in science subjects decreases by 9.44%. The increase in the score of openness to experience increases the grade in science subjects by 7.58% (OR = .92, 95% CI = .84 - 1.02). Achieving approach is a significant predictor for the grades obtained in science subjects (Wald = 5.06, p <0.05), it contributes with 6.68% to the increase in results (OR = .93, 95% CI = .88 - .99).

After applying the Nagelkerke R² test, we can conclude that the explanatory power of the model is 26%, that is, the variables introduced into the model explain the performance achieved in science subjects by 26%. The odds ratio of the entire model and the fit of the data processed in the model was determined by the Hosmer and Lemeshow test. The test result is not significant [χ^2 (8) = 4.95, p> 0.05], so the model has acceptable fit (Table 5).

After determining the extent to which the predictors included in the model determine performance in science subjects, based on a multi-step model, we have examined the extent of their explanatory power.

Table 6

Multistep Model: Individual explanatory power of predictors for average grade in science subjects (N=87)

Steps	Predictors	B	SE	Wald	p	Odds Ratio	Chance for increasing/ decreasing	Nagelkerke R²	Hosmer-Lemeshow test		
									χ^2	df	p
Step 1	Surface strategy	.12	.04	7.09	.008	1.13	-11.97	.117	11.19	8	.19
Step 2	Surface strategy	.12	.05	6.24	.012	1.13	-11.66	.188	6.30	7	.50
	Openness	-.10	.04	4.75	.029	.90	10.49				
Step 3	Surface strategy	.09	.05	3.67	.055	1.10	-9.44	.260	4.95	8	.76
	Openness	-.07	.04	2.31	.128	.92	7.58				
	Achie-ving approach	-.06	.02	5.06	.024	.93	6.68				

The first step was to introduce surface strategy into the model, whose explanatory power, according to Nagelkerke R², is 11.7%, i.e. an 11.97% decrease in performance in science subjects, if surface strategy increases by one unit (point). After the first step, the model has acceptable fit, as the result of the Hosmer-Lemeshow test is not significant [$\chi^2 (8) = 11.19$, $p > 0.05$].

In the second step, we introduced into the model openness, as one of the personality traits. As a result, the explanatory power of the model increased to 18.8% (Nagelkerke R² = .188), i.e. openness increased the explanatory power of the model by 7.1%. In this model, a one-point increase in surface strategy decreases performance by 11.6%, and a one-point increase in the score of openness increases performance in science subjects by 10.49%. The quality of the data included in the two-variable model is also appropriate [$\chi^2 (7) = 6.30$, $p > 0.05$].

In the third step, besides surface strategy and openness, we introduced to the model the achieving approach, too. Thus, the explanatory power of the model increased to 26%, the achieving approach increased the explanatory power of the model by 7.2% (Nagelkerke R² = .260). In the final model, surface strategy decreases student performance by 9.44%, openness increases it by 7.58% in science subjects, while achieving approach increases the average grade obtained in science subjects by 6.68%. The quality of the applied data and the complete model fit being checked with the

Hosmer-Lemeshow test [χ^2 (8) = 4.95, p> 0.05], we can state that this model can be considered reliable (Table 6).

Table 7

Model 2: Predictors of performance in humanities (N=80)

Predictor	B	SE	Wald	df	p	Odds Ratio	Chance for increasing/ decreasing	95% C.I.for EXP(B) Lower	U pper
Neuroticism	-.21	.06	10.00	1	.002	.81	23.45	.71	.92
Openness	-.02	.07	.10	1	.749	.97	2.37	.84	1.12
Surface strategy	.29	.09	9.59	1	.002	1.33	-25.25	1.11	1.60
Deep strategy	-.17	.09	3.32	1	.068	.83	19.28	.69	1.01
Achieving approach	-.17	.06	8.66	1	.003	.83	19.41	.74	.94
Constant	8.90	3.72	5.73	1	.017	7391.31			

Note. Nagelkerke R²=.689; Hosmer and Lemeshow test χ^2 (8) = 6.13, p = .63; CI = Confidence interval

Similarly to the predictors determining the average grades in science subjects, based on the odds ratio of the variables, we also calculated whether the chances of good performance in humanities increase or decrease due to the factors included in the model. Similarly to science subjects, the most decisive factor in the case of humanities as well, is surface learning strategy, which significantly predicts performance (Wald = 9.59, p <0.01), its one unit increase decreases the average grade in humanities by 25.25% (OR=1.33, 95% CI = 1.11 – 1.60).

The second most important factor is neuroticism, a significant predictor of performance in humanities (Wald = 10.00, p <0.01), a one unit increase of neuroticism increases performance in humanities by 23.45% (OR = .81, 95% CI = .71 -. 92). Achieving learning approach also significantly determines performance (Wald = 8.66, p <0.01), a one unit increase in it increases the average grade in humanities by 19.41% (OR = .83, 95% CI = .74 - .94), deep learning strategy increases performance in humanities by 19.28% (OR = .83, 95% CI = .69 - 1.01), while a one unit increase of openness increases the average grade in humanities by only 2.37% (OR = .97, 95% CI = .84 - 1.12).

We conducted a Nagelkerke R² test as well, in order to determine the model's explanatory power, based on which the variables included in the model explain 68.9% of the results achieved in humanities. The complete model's goodness of fit and the quality of variables and data included in the model were determined in accordance with the Hosmer-Lemeshow test [χ^2 (8) = 9.63, p> 0.05]. The fit of the model and the data tested is acceptable, as the test result is not significant (Table 7).

After determining the extent to which the variables included in the model influence the evolution of the grades in humanities, we examined their explanatory power individually in a multi-step model.

Table 8

Multistep model: Individual explanatory power of predictors of the average grade in humanities (N=80)

Steps	Predictors	B	SE	Wald	p	Odds Ratio	Chance for increasing/ decreasing	Nagelkerke R²	Hosmer-Lemeshow test		
									χ^2	df	p
Step 1	Surface strategy	.167	.051	10.748	.001	1.182	-15.39	.196	5.73	8	.67
Step 2	Surface strategy	.188	.056	11.247	.001	1.207	-17.12	.297	6.53	8	.58
	Neuroticism	-.096	.038	6.500	.011	.909	10.03				
Step 3	Surface strategy	.255	.085	9.002	.003	1.290	-22.47	.660	10.26	8	.24
	Neuroticism	-.178	.059	9.092	.003	.837	19.49				
	Achieving Approach	-.220	.055	15.782	.000	.803	24.60				
Step 4	Surface strategy	.293	.094	9.606	.002	1.340	-25.37	.688	4.70	8	.78
	Neuroticism	-.208	.066	9.981	.002	.812	23.10				
	Achieving approach	-.185	.057	10.393	.001	.831	20.29				
	Deep strategy	-.171	.095	3.244	.072	.843	18.63				
Step 5	Surface strategy	.291	.094	9.594	.002	1.338	-25.25	.689	6.13	8	.63
	Neuroticism	-.211	.067	10.006	.002	.810	23.45				
	Achieving approach	-.177	.060	8.660	.003	.837	19.41				
	Deep strategy	-.176	.097	3.328	.068	.838	19.28				
	Openness	-.023	.073	.103	.749	.977	2.37				

The first variable introduced in the model is surface learning strategy, as it determines the most performance in humanities, decreasing the results in humanities by 15.39% per unit increase (Table 8). In this initial step, the model's explanatory power is 19.6%, based on the Nagelkerke R^2 indicator. The variable used in the model, i.e. surface approach, can be considered reliable, since the result of the Hosmer-Lemeshow test is not significant [$\chi^2(8) = 5.73$, p> 0.05].

In the second step, in addition to surface learning strategy, neuroticism was also introduced into the model. In this case, surface strategy decreases performance in humanities by 17.12% and the increase of neuroticism increases it by 10.03%. Based on Nagelkerke R^2, introduction of neuroticism into the model, increases the explanatory power of the model by 10.1%, so the complete model with two predictors has a 29.7% explanatory power. The fit of the model with two variables is acceptable because the result of the Hosmer-Lemeshow test is not significant in this case either [$\chi^2(8) = 6.53$, p> 0.05].

In the third step, in addition to surface learning strategy and neuroticism, we also introduced the achieving learning approach to the model; thus the model's explanatory power increased to 66% (Nagelkerke R^2 = .660). Achieving learning strategy increased by 36.6% the explanatory power of the model in terms of performance in humanities. In this model, the one unit increase in the surface learning strategy decreases performance by 22.47%, the one unit increase of neuroticism by 19.49%, and the one unit increase of achieving learning strategy increases by 24.6% the results achieved in humanities. The fit of the data used in the three variable model is also acceptable [$\chi^2(8) = 10.26$, p> 0.05].

In the fourth step, we introduced deep learning strategy into the model as well, its explanatory power increased by only 2.8%, i.e. to 68.8% (Nagelkerke R^2 = .688). In this model, the one unit decrease of surface learning strategy decreases the result in humanities by 25.37%. The one unit increase in neuroticism decreases results in humanities by 23.10%, and the one unit increase of achieving approach by 20.29%. The one unit increase of deep strategy increases performance in humanities by 18.63%. The fit of a model with three different learning strategies and neuroticism is considered acceptable [$\chi^2(8)=4.70$, p>0.05].

In the fifth step, we introduced openness to experiences, too in the model as the last variable, which increased the explanatory power of the model by only 0.1%. The final model thus explains performance in humanities by 68.9% (Nagelkerke R^2 = .689). Increase of surface strategy decreases by 25.25%, neuroticism increases the chance of obtaining good results in humanities by 23.45%, achieving approach increases it by 19.41%, deep strategy by 19.28%, and openness by 2.37%. The final model is acceptable fit [χ^2 (8) = 6.13, p> 0.05].

Table 9

Model 3: Predictors of average grades (N=71)

Predictor	B	SE	Wald	df	p	Odds Ratio	Chance for increasing/ decreasing	95% C.I.for EXP(B) Lower	Upper
Conscientiousness	.01	.04	.07	1	.785	1.01	1.33	.92	1.11
Openness	-.13	.05	5.29	1	.021	.87	14.56	.77	.98
Surface strategy	.19	.07	7.25	1	.007	1.2	-17.92	1.05	1.40
Deep approach	.01	.06	.05	1	.823	1.01	1.47	.89	1.15
Achieving approach	-.12	.05	5.86	1	.015	.88	13.10	.80	.97
Constant	4.04	2.80	2.07	1	.149	57.34			

Note. Nagelkerke R^2=.545; Hosmer and Lemeshow test χ^2 (8) = 9.63, p = .29; CI = Confidence interval

In the third regression model, based on the odds ratio of the variables introduced into the model, conscientiousness, as a personality trait, has the smallest effect on increasing chances. It increases by only 1.33% the chance of an average grade increase, i.e. increase in all subjects' average (Table 9). More conscientious students achieve higher GPA (OR = 1.01, 95% CI = .92 - 1.11). Similarly, deep learning approach increases the chance for a student to perform well by 1.47% only, and students with deep learning approach

achieve a higher GPA (OR = 1.01, 95% CI = .89 - 1.15).). On the other hand, openness to experience explains the good academic performance to a greater extent i.e. by 14.56%, it is a significant predictor for the average grade (Wald = 5.29, p <.05); more open-minded students can obtain higher average grades (OR = .87, 95% CI = .77 - .98). Similarly, achieving learning approach also determines grade increase by 13.10%, significantly predicts GPA (Wald = 5.86, p <.05), its use contributes to the increase of learning outcomes (OR = .88, 95% CI = .80 - .97). Contrary to this, surface learning strategy significantly, and to a great extent, decreases the chance of the average grade growth, i.e. by 17.92% (Wald = 7.25, p <.01). Surface learning strategy results in a decrease in the average grade (OR = 1.2, 95% CI = 1.05 - 1.40).

We used Nagelkerke R^2 and Hosmer-Lemeshow tests as well. Based on the Nagelkerke R^2 test, the variables introduced in the model explain 54.5% of the average grade. Goodness of fit is the result of the Hosmer and Lemeshow test, which is not significant [$\chi^2 (8) = 9.63$, p> 0.05], so the model and the data included in the model can be considered acceptable fit.

In the case of the average grade, we also examined what the chances of increase in results are, when introducing the variables individually into the logistic model.

Table 10

Multistep model: Individual explanatory power of predictors of average grade (N=71)

Steps	Predictors	B	SE	Wald	p	Odds Ratio	Chance for Increasing/ decreasing	Nagel-kerke R²	Hosmer-Lemeshow test χ² df p		
Step 1	Surface strategy	.203	.059	11.863	.001	1.225	-18.36	.253	14.41	8	.07
Step 2	Surface strategy	.242	.067	13.004	.000	1.274	-21.49				
	Openness	-.167	.054	9.565	.002	.846	18.15	.423	7.40	8	.49
Step 3	Surface strategy	.194	.071	7.427	.006	1.214	-17.60				
	Openness	-.132	.058	5.113	.024	.876	14.10	.544	8.06	8	.42
	Achieving approach	-.114	.040	8.199	.004	.892	12.06				
Step 4	Surface strategy	.193	.071	7.400	.007	1.212	-17.51	.544	7.18	8	.51
	Openness	-.133	.058	5.260	.022	.875	14.23				
	Achieving approach	-.122	.051	5.743	.017	.885	12.94				
	Deep Approach	.017	.065	.066	.797	1.017	1.69				
Step 5	Surface strategy	.198	.073	7.250	.007	1.218	-17.92	.545	9.63	8	.29
	Openness	-.136	.059	5.295	.021	.873	14.56				
	Achieving approach	-.123	.051	5.860	.015	.884	13.10				
	Deep approach	.015	.066	.050	.823	1.015	1.47				
	Conscien-tiousness	.013	.049	.074	.785	1.013	1.33				

In the first step, we introduced surface learning strategy into the model, which in itself decreases the chance of the GPA growth by 18.36%, and explains the average grade based on the calculation of the Nagelkerke R² indicator. Goodness of fit of the single variable model was determined based on the results of the Hosmer and Lemeshow test, which is not significant [$\chi^2 (8) = 14.41$, p> 0.05], so the model can be considered acceptable fit.

In the next step, we introduced openness to experience into the model, whose one unit increase increases the chance of GPA growth by 18.15%, which increases the model's explanatory power to 42.3% based on the Nagelkerke R^2 indicator, i.e. its contribution to the explanatory power of the model is 17%. For the two variable model, it can also be established, based on the result of the Hosmer-Lemeshow test $[\chi^2(8) = 7.40, p > 0.05]$, that the fit of the data included in the model is acceptable. In this model, the one unit increase of surface learning strategy decreases the chances of an average grade growth by 21.49%, contributing to a low GPA.

In the third step, we have introduced achieving approach into the model, which increases the chances of an average grade increase by 12.06%; openness to experience by 14.10%, while surface strategy contributes to a 17.6% decrease in the average grade. Achieving approach, based on the Nagelkerke R^2 indicator, increases the explanatory power of the model by 12.1%, i.e. to 54.4%. The data fit of the three variable model is also acceptable $[\chi^2(8) = 8.06, p > 0.05]$.

The fourth variable, the deep strategy, although in itself significantly correlates with the GPA, does not significantly determine the development of the GPA in the logistic model, it does not change the explanatory power of the model either, and increases the chance of average grade growth by 1.69%. Similarly, conscientiousness does not contribute significantly to the average grade, it increases grade growth by only 1.33%, and increases the model's explanatory power by 0.1% i.e. to 54.5%, based on the Nagelkerke R^2 indicator. The four variable $[\chi^2(8) = 7.18, p > 0.05]$ and the five variable models $[\chi^2(8) = 9.63, p > 0.05]$ has also acceptable fit (Table 10).

Discussion and conclusions

After processing the data, we can conclude that the first hypothesis has been confirmed. Of the five personality traits, conscientiousness, openness and neuroticism are related to the study indicators investigated by us; contrary to this, there is no significant correlation between agreeableness, extraversion and the grades obtained. There is also a significant, positive, although weak correlation between conscientiousness and GPA, as well as the average performance in science subjects. This finding confirms the conclusion of

Richardson, Abraham and Bond (2012) that more conscientious students have higher average grades. In our sample, too we can show that more conscientious students perform better in school tasks, which is due to their organizational skills and their performance orientation (O'Connor & Paunonen, 2007), they are more inclined to plan, and follow the steps in the plan towards achieving their goals (Caprara, Wecchione, Alessandri, Gerbino & Barbaranelli, 2011). More conscientious students perform better in science subjects as well, where persistence plays a key role, as they require a lot of practice (Mac Cann, Duckworth & Roberts, 2009)..

Openness affects all three study indicators examined. There is a significant positive correlation with both the GPA and performance in humanities and science subjects. This result is in line with the conclusions of Lounsbury, Sundstrom, Loveland and Gibson (2003) according to which, openness is linked to high performance, the GPA and the qualifications obtained in each subject. A similar positive correlation between Mathematics and openness has already been discovered, which, based on our findings, correlates significantly with deep and achieving learning approaches, which greatly determine the study of science subjects (Chamorro-Premuzic & Furnham, 2009; Heaven & Ciarrochi, 2012). Deep learning approach assumes an accurate, detailed understanding of the information, and the achieving approach contributes to the development of a competitive spirit.

There was no significant correlation between neuroticism and GPA, and performance in science subjects, but it is in positive correlation with performance in humanities. Neuroticism, the moderate level of anxiety, promotes better performance in humanities. This is the same as Nighute's and Sadawarte's (2014) research findings, who also found a significant positive correlation between neuroticism and learning outcomes, and identified it as a major predictor of learning performance, similarly to current research results.

Considering the learning approaches, a significant positive correlation can also be found between deep and achieving learning approach and the GPA, as well as performance in humanities and science subjects. The deep and achieving motives and strategies contribute to high level learning outcomes (Chamorro-Premuzic & Furnham, 2008). Surface learning approach negatively correlates with the average grade, the

results obtained in humanities and science subjects, so it contributes to low level academic performance, and students using surface learning approach achieve lower results (Furnham, Monsen & Ahmetoglu, 2009). Based on these findings, our second hypothesis was also confirmed.

Binary logistic regression analysis for the third hypothesis testing shows that surface learning approach decreases both the average grade and the results obtained in humanities and science subjects. In all three regression models, this learning strategy has the greatest explanatory power. Achieving learning approach is also emerging in all three models, thus contributing to better performance, and significantly increases the level of achievements in both humanities and science subjects. Deep learning approach promotes the chance of average grade growth in humanities and GPA. If students have a deep learning approach, the chances of achieving higher grades increase. Of the five personality traits, conscientiousness and openness contribute to the increase of students' average grade, the more conscientious and open the student to the new experiences, the higher the level of learning outcomes. The chances of increasing performance in humanities are enhanced by neuroticism and openness. In the case of science subjects, from all personality traits, openness is of paramount importance. Thus, openness plays a significant role in all three models, its one unit change contributes to increase in GPA, as well as in performance in both humanities and science subjects.

The main limitation of the research is the scarcity of instruments applied and the fact that all the sample came from the same high school. These shortcomings can be avoided in the future and the findings would provide a more global picture and could be better generalized, if we included in the research students from several schools.

Further development of research would be to explore more widely the factors determining school success, to explore what other cognitive, motivational, emotional coefficients and social indicators determine the quality of learning in addition to personality dimensions and learning approaches. Further development would be to work out and implement an intervention plan to increase students' motivation, as students with surface motives have lower grades. It would be useful to have motivational trainings for students and, of course, to carry out pre-and post-assessment to determine if their learning motives change as a result of the interventions.

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