

## Distinguishing successful students in mathematics – A comparison across European countries

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This study explores factors distinguishing students with the optimal pattern of high mathematics achievement and their positive self-related mathematics beliefs across 17 European regions using PISA 2012 data. Hierarchical cluster analysis with variables mathematics anxiety, students' achievement and students' perception of mathematics efficacy, mathematics self-concept and intrinsic motivation was used for this purpose. This yielded 4 different student groups. The profile of successful mathematics students (low mathematics anxiety, high achievement and highly perceived mathematics efficacy, self-concept and intrinsic motivation) was among them. The results indicate differences in the factors relevant to students' success in mathematics depending on whether their country mathematics literacy and mathematics anxiety scores are above or below the OECD average. Students' socio-economic and cultural background and experience with pure mathematics tasks are factors relevant across all examined countries.

*Keywords:* PISA, mathematics, successful students

### Highlights:

- High math score, high self-related beliefs, and low anxiety add to success in math.
- There are country-specific factors relevant for students' success in math.
- Students' ESCS is relevant for success in math across all countries.
- Experience with pure math tasks is related to success in math across all countries.

A number of variables have been used to predict students' achievement in mathematics. Among them self-related beliefs in mathematics, interest and

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*Acknowledgement.* This work was partially supported by the Ministry of Education, Science and Technological Development of Serbia, grant number 179018.

mathematics anxiety have been of particular interest to researchers (Stankov & Lee, 2017). Conversely, numerous studies have confirmed a negative relationship between mathematics anxiety and students' achievement in mathematics (Chang & Beilock, 2016), while the reverse pattern is observed for mathematics self-efficacy and self-concept (Marsh, 2007; Schunk & Pajares, 2009). Results of the Programme for International Student Assessment (PISA) 2012 show that across the cluster of countries belonging to the Organisation for Economic Co-operation and Development (OECD), higher levels of mathematics anxiety are linked with a 34-point lower score in mathematics test, while low mathematics self-efficacy is linked with a difference of 49 score points in mathematics (OECD, 2013b). Both are the equivalent of more than one school year. Grounded in the work on relevance of self-related beliefs, interest and anxiety for achievement in mathematics, we examine factors distinguishing students with the optimal pattern of high mathematics achievement and positive self-related mathematics beliefs across the range of countries in Europe.

### **Theoretical Background**

Over the past decades students' motivational beliefs were regarded as the driving force behind their learning (Liou, 2017; Wigfield, Tonks, & Klaua, 2009), coupled with the idea of the necessity for students to develop a positive academic self-concept which further facilitates their subsequent academic accomplishments (Marsh et al., 2015). At the same time particular emphasis was also given to the idea that students' anxiety and worry about their own academic achievement have profound repercussions for their learning and school achievement (Ahmed, van der Werf, Kuyper, & Minnaert, 2013; Lauermaun, Eccles, & Pekrun 2017).

The latter were examined under the scope of academic emotions, and were defined as emotions tied directly to learning, instruction, and achievement in the school setting (Pekrun, Frenzel, Goetz, & Perry, 2007a). Within Pekrun's control-value theory four groups of academic emotions can be distinguished among which worry and anxiety are observed as negative activating emotions leading to more superficial learning strategies and thus poorer outcomes (Pekrun et al., 2007a). Together with the work of Eccles and colleagues (Wigfield & Eccles, 2000) is the idea that expectations of success in a given task, and how much the task itself is valued, governs students' achievement. These have given profound theoretical grounds for a plethora of research dealing with academic emotions and subject self-related beliefs, especially in mathematics.

As such, mathematics anxiety is recognized as a multidimensional construct (Pekrun, 2006) and largely understood as a feeling of tension during which students experience negative reactions while dealing with diverse mathematics concepts or encounter situations in which their mathematics knowledge is tested (Kazelskis et al., 2000; Stankov & Lee, 2017; Zeidner & Matthews, 2011). As a result, they may evade prospective mathematics related

careers (Ashcraft & Ridley, 2005), education paths which include mathematics (Nuanez-Pena, Suarez-Pellicioni, & Bono, 2013) and/or situations comprising mathematics in everyday life (Artemenko, Daroczy, & Nuerk, 2015). In addition, researchers have debated that for interest to grow in relation to a school subject, like mathematics, it is important that students experience positive emotions linked to the activity itself (Pintrich, 2000; Schiefele, 2009).

Overall, low achievement in mathematics is related with high mathematics anxiety (Chang & Beilock, 2016; Ma & Xu, 2004) and results largely show that a number of students who experience anxiety tend to fail in mathematics tasks compared to students with no or low levels of anxiety (Hembree, 1990; Ma, 1999). Also, when observing students for an extended period of time, the indication is that their anxiety levels remains stable across the period (Ahmed et al., 2013).

In addition to mathematics anxiety, self-efficacy (i.e., one's belief that he (she) can, through their actions, produce desired effects, Bandura, 2001), together with self-concept in mathematics (i.e., perceived competence in mathematics), consistently show a strong relationship with achievement (Hwang, Choi, Lee, Culver, & Hutchison, 2016; Stankov & Lee, 2017) and to be its strong predictor (Komarraju & Nadler, 2013; Robbins et al., 2004; Skaalvik, Federici, & Klassen, 2015). Students with low levels of mathematics self-efficacy are under the risk of failing in mathematics, despite their own competences (Schunk & Pajares, 2009). High self-concept level is also associated with positive learning outcomes (Marsh, 2007). Although both cross-sectional and longitudinal studies of self-concept and achievement point to consistent positive relations among these (Marsh, 2007), the latter also give evidence of their reciprocal relationship over time (Marsh, Xu, & Martin, 2012; Viljaranta, Tolvanen, Aunola, & Nurmi, 2014).

Results of large scale assessment (LSA) studies point to significant variance across countries and economies when it comes to students' perceptions of their own efficacy and/or related anxiety and intrinsic interest to learn mathematics, specified as finding learning mathematics interesting and enjoyable (Lee, 2009; Liou, 2017; OECD, 2013b; Schütte, 2015). Just in 2012 alone across the PISA participating countries, 43% of students reported perceiving themselves as not good at mathematics, around 30% reported feeling helpless when doing mathematics problems and 59% reported worrying about encountering possible difficulties in mathematics classes (OECD, 2013b). In addition, to date besides the economic social and cultural status (ESCS) measures, self-belief measures are among the strongest predictors of student achievement when observing the LSA data. Except these, structured lesson time at school (divided as experience with pure and applied mathematics task) is an important pre-requisite for students to develop mathematical literacy assessed in the PISA framework (OECD, 2013a; Scheerens & Bosker, 1997; Seidel & Shavelson, 2007).

ESCS measures in both Trends in International Mathematics and Science Study (TIMSS) and PISA correlate from 0.30 to 0.40 with achievement, while

children with higher ESCS on average attain higher scores in achievement tests regardless of the domain (Baucal, 2012; Gustafsson, Hansen, & Rosen, 2013; OECD, 2013b). As for the self-beliefs measures, in PISA, the mathematics self-efficacy correlates in the upper .40s (positive relationship) with achievement, mathematics anxiety measure are in the upper .30s (negative relationship), while self-concept in mathematics has a correlation of about 0.25 (positive relationship, Stankov & Lee, 2017). From concepts capturing the school atmosphere, disciplinary climate is the only one in this range.

Although the evidence seems to be consistent on the importance of anxiety, motivational and self-related beliefs for the overall mathematics achievement and later learning trajectories, little is known as to whether across countries we can speak of similar student profiles when observing jointly their mathematics achievement, anxiety and related self-beliefs. While LSA data do allow for cross country comparisons, to our knowledge these were used to examine variations in one dimension at the time. Thus, the focus of this study is (1) to identify subgroups of students with different patterns in mathematics achievement, mathematics anxiety and mathematics related self-beliefs (students' perception of own mathematics efficacy, self-concept in mathematics and intrinsic motivation); (2) to compare distribution of these subgroups in selected European countries; and (3) to identify factors differentiating students with the optimal pattern of high mathematics achievement and positive self-related mathematics beliefs. The comparison between different European countries is the main concern of this paper.

Based on the given aims on the study, we have posited the following hypotheses:

H1: Our anticipation is that two distinctive students' subgroups will be identified: a successful group (distinguished by high math achievement, high math self-beliefs and intrinsic motivation, coupled with low math anxiety) and an unsuccessful group (distinguished by low math achievement and related self-beliefs and motivation, coupled with high math anxiety). The assumption is grounded in the results of aforementioned empirical studies which suggest negative linear relationship between anxiety and achievement and positive relationship between self-beliefs, motivation and achievement.

H2: Distribution of identified subgroups will correspond to the average achievement and anxiety indexes at the country level.

H3: Based on previous empirical evidence on the importance of the ESCS (Baucal, 2012; Gustafsson et al., 2013; OECD, 2013b; Stankov & Lee, 2017), experience with the mathematics tasks (OECD, 2013a; Scheerens & Bosker, 1997; Seidel & Shavelson, 2007) and disciplinary climate (Stankov & Lee, 2017) relative to achievement, we assume these parameters to be predictive of

students' belonging to the successful group. Given the explorative nature of the study, no particular assumptions were made as for the differences between the countries on the predictive power of the variables examined in the study.

## Method

### Sample

The study uses mathematics data from PISA 2012. Based on mathematics achievement scores and observed mathematics anxiety from that cycle (i.e. high achievement countries against low achieving countries in mathematics and countries with high and low perceived mathematics anxiety among the students), sixteen European countries were selected for the purpose of the analyses (OECD, 2013b). Total sample included around 93 000 students. Country overview and specifics are displayed in Table 1.

Table 1  
*Sample quota by country*

	Country/Region	Total number (Girls, %)
Mathematics achievement above the OECD average.	Austria	4755 (50.14%)
	Germany	5001 (49.13%)
Mathematics anxiety below the OECD average.	Finland	8829 (48.65%)
	the Netherlands	4460 (48.83%)
	Switzerland	11229 (49.92%)
Mathematics achievement and anxiety above the OECD average.	Belgium–Flemish Community	4877 (49.81%)
	Belgium–other	3720 (49.81%)
	Ireland	5016 (49.17%)
	Slovenia	5911 (48.22%)
Reference country	Norway	4686 (51.27%)
Mathematics achievement below the OECD average.	Bulgaria	5282 (48.23%)
	Croatia	5008 (49.02%)
Mathematics anxiety above the OECD average.	Romania	5074 (51.03%)
	Serbia	4684 (50.23%)
Mathematics achievement and anxiety below the OECD average.	Hungary	4810 (51.78%)
	Slovak Republic	4678 (47.64%)
	Sweden	4736 (49.55%)

The PISA framework anticipates that the country samples are formed in two phases. Firstly, a school sample is selected from a total list of schools controlling for the student population of interest (students age 15). Following this, a simple random sample of 35 students is taken from each selected school.<sup>1</sup> In each cycle, the sample is stratified by geographical regions and types of schools relevant to the country in question.

1 If less than 35 15-year-old students attend the selected school, all of the students will be invited to partake in the PISA survey.

## Instruments

The PISA 2012 assessment was a paper-and-pencil test for the major domains<sup>2</sup>; while the question format varied<sup>3</sup>. To collect contextual information, in each cycle, PISA requests students to answer to background questionnaires, which provide information about a range of student and school characteristics<sup>4</sup>. In 2012 the central topic of the Survey was mathematics, meaning that the students' questionnaire was devoted to the inquiry on the relationship towards mathematics as a school subject, including questions on students' perceptions of mathematics anxiety, interest in mathematics, self-concept and self-efficacy in mathematics.

## Variables

Central variables of the inquiry are mathematics anxiety (ANXMAT), interest in and enjoyment in mathematics (INTMAT), mathematics self-efficacy (MATHEFF), mathematics self-concept (SCMAT) and achievement in mathematics (MATPISA). The latter is measured as a global achievement on PISA mathematics literacy scale, while other measures represent composite variables made of Likert type scale items. ANXMAT refers to different aspects of mathematics anxiety (feeling worry, helplessness or nervous when encountering mathematical problems or worrying about getting poor marks); and INTMAT focuses on whether students enjoy reading about mathematics, look forward to mathematics lessons and why they do and learn mathematics. MATHEFF explores the extent students feel confident doing a range of pure and applied mathematical tasks, while SCMAT examines students' perceptions on understanding and learning mathematics concepts quickly, or doing good and getting high grades in mathematics (OECD, 2014). These variables served as the basis for selecting different groups of students discussed later in the paper.

Two variable groups were used as predictors when assessing students' success in mathematics: demographical variables and variables describing school and classroom atmosphere. Variable specifics and item examples are given in Table 2.

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2 Language, mathematics and science.

3 Questions may request students to produce simple answers (e.g., a multiple-choice item), or to produce their own responses. Examples of released items may be found at <http://www.oecd.org/pisa/pisaproducts/pisa2012-2006-rel-items-maths-ENG.pdf>

4 These include information about students' and their family backgrounds; aspects of students' lives (i.e., life inside the school); strategies of self-regulated learning, motivational preferences; and aspects of learning and instruction (e.g., students' motivation, engagement and confidence in respect to the major domain of assessment).

Table 2  
Description of variables used in the analysis

Variable	Description
	<i>Mathematical achievement</i>
Achievement in PISA mathematical literacy (MATPISA)	Average score at the country level.
	<i>Demographical variables</i>
Index of economic, social and cultural status (ESCS)	A composite measure of parents' educational attainment, parents' occupation, parents' occupation prestige, economical status and cultural resources the family has access to.
	<i>School and classroom atmosphere</i>
Mathematics anxiety (ANXMAT)	Example: "I often worry that it will be difficult for me in mathematics classes." and "I feel helpless when doing a mathematics problem."
Interest in and enjoyment of mathematics (INTMAT)	Example: "I enjoy reading about mathematics."
Mathematics self-efficacy (MATHEFF)	Students assessed level of certainty that they can solve 8 types of mathematics problems that were offered e.g. "Understanding graphs presented in newspapers"
Mathematics self-concept (SCMAT)	Example: "I am just not good at mathematics."
Teacher support (TEACHSUP)	Example: "The teacher shows an interest in every student's learning."
Teacher Behaviour: Formative Assessment (TCHBEHFA)	Example: "The teacher gives me feedback on my strengths and weaknesses in mathematics."
Teacher Behaviour: Student Orientation (TCHBEHSO)	Example: "The teacher assigns projects that require at least one week to complete"
Teacher Behaviour: Teacher-directed Instruction (TCHBEHTD)	Example: "The teacher tells us what we have to learn."
Mathematics teacher's support (MTSUP)	Example: "My teacher lets us know we need to work hard."
Disciplinary climate (DISCLIMA)	Example: "Students don't listen to what the teacher says."
Classroom management (CLSMAN)	Example: "My teacher keeps the class orderly."
Cognitive activation in mathematics lessons (COGACT)	Example: "The teacher asks questions that make us reflect on the problem."
Student teacher relations at school (STUDREL)	Example: "Students get along well with most teachers."
Experience with applied mathematics tasks at school (EXAPPLM)	Example: "Calculating how many square metres of tiles you need to cover a floor."
Experience with pure mathematics tasks at school (EXPUREM)	Example: "Solving an equation like $6x^2 + 5 = 29$ "
Subjective norms in mathematics (SUBNORM)	Example: "My parents believe it's important for me to study mathematics."

Note. Variables related to school and classroom atmosphere and motivational and cognitive aspects in mastering mathematics were used in accordance with the definitions given in the PISA 2012 Technical report (OECD 2014).

To account for the planned missing data design in PISA 2012 (OECD, 2014) missing value analysis with multiple imputations was performed prior subsequent analyses on all non-cognitive variables of interest at a country level using NORM 2.03 (Graham, 2012). For all countries EM (with Maximum-Likelihood Estimate) converged normally.

## Analyses

Firstly, hierarchical cluster analysis (Ward method) with SPSS 24 was implemented on 10% of randomly chosen student sample (around 9300 students). Variables in the analysis were ANXMAT, INTMAT, MATHEFF, SCMAT and MATPISA. The results were replicated for the whole sample using K-means clustering. The procedures were replicated in several iterations, yielding the same results. Clustering procedures are deemed as most useful in the data mining process for discovering groups and/or specific patterns in the underlying data (Field, 2013; Tabachnick & Fidell, 2007). In addition, discriminant analysis was used to deepen our understanding of differences between the clusters. Secondly, the profile of students succeeding in mathematics was analysed at the country level and against a non-cognitive set of predictors related to the class and school surrounding. The index of economic, social and cultural status (ESCS) was also included in the analysis. The latter analyses were performed in Mplus 7 (Muthén & Muthén, 1998–2013).

## Results

The results section is divided into two parts. In the first we described results related to the extracted student groups, whereas in the second part we observed predictors relevant for students' success in mathematics relative to the country background.

### Differentiated student groups

The results of the cluster analysis singled out four different student groups. Results of the final replication are described. Based on discriminative analysis, three statistically significant discriminative functions were found, contributing further differentiation between the groups, with 97% of cases accurately classified. The first one was saturated with students' perception of own high self-concept and high self-efficacy in mathematics ( $\lambda (15) = .118, r = .884, p < .001$ ). The second discriminative function was comprised of variables pointing to low achievement in mathematics, combined with high interest in the subject ( $\lambda (8) = .540, r = .675, p < .001$ ). The last one was saturated with mathematics anxiety ( $\lambda (3) = .991, r = .095, p < .001$ ).<sup>5</sup>

Taking into account the above-mentioned parameters we could observe the following specifics for the four student profiles. The first group (labelled

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5 Results of the discriminative analysis on random sample have singled out also three statistically significant discriminative functions. First was saturated with students' perception of own high self-efficacy and self-concept in mathematics ( $\lambda (15) = .187, r = .840, p < .001$ ), followed by function saturated with low achievement and high interest in the subject ( $\lambda (8) = .637, r = .585, p < .001$ ) and the last one with mathematics anxiety ( $\lambda (3) = .969, r = .176, p < .001$ ).



as the *uninterested achiever*) gathered students with higher scores in PISA mathematics test. These students were not interested in mathematics, and have exhibited low levels of mathematics anxiety. The second group received highest achievement scores in mathematics and was interested in the subject. These students perceived themselves as confident when they encounter a different range of mathematics tasks, and felt they understand and learn mathematics concepts quickly. We have labelled them as the *'successful group'*. The next student profile could be described as anxious, but interested in mathematics. However, these students have failed in mathematics and have perceived own mathematics-efficacy and self-concept as low. We refer to them as the *'anxiously interested'* group. The final group, labelled as the *'underachievers'*, was marked by high anxiety and low interest in mathematics. These students have also gained low achievement scores and have perceived own mathematics-efficacy and self-concept as low.

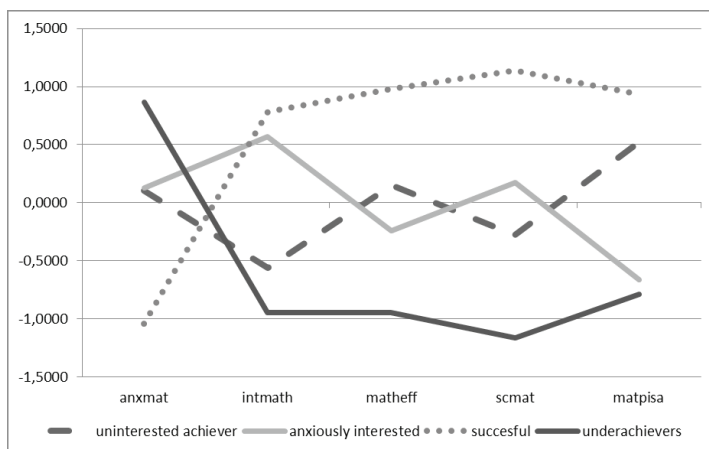


Figure 1. Overview of extracted student groups

Countries have differed as to the frequency of each of the described profiles ( $\chi^2(48) = 9484.79, p < .001$ ). When observing for particular patterns in these variations, accounting for the specific country groups (i.e., high achievement countries against low achieving countries in mathematics and countries with high and low perceived mathematics anxiety among the students) we observed the *'successful group'* to be significantly more frequent in Germany, the Netherlands, Austria, Switzerland and Finland. These countries were characterized by higher achievement in mathematics and lower anxiety at the country level, when observed against the OECD average. All five countries had also significantly less students in the *'anxiously interested'* group and all but Finland more students than expected in the *'uninterested achiever'* group (please see Figure 2).

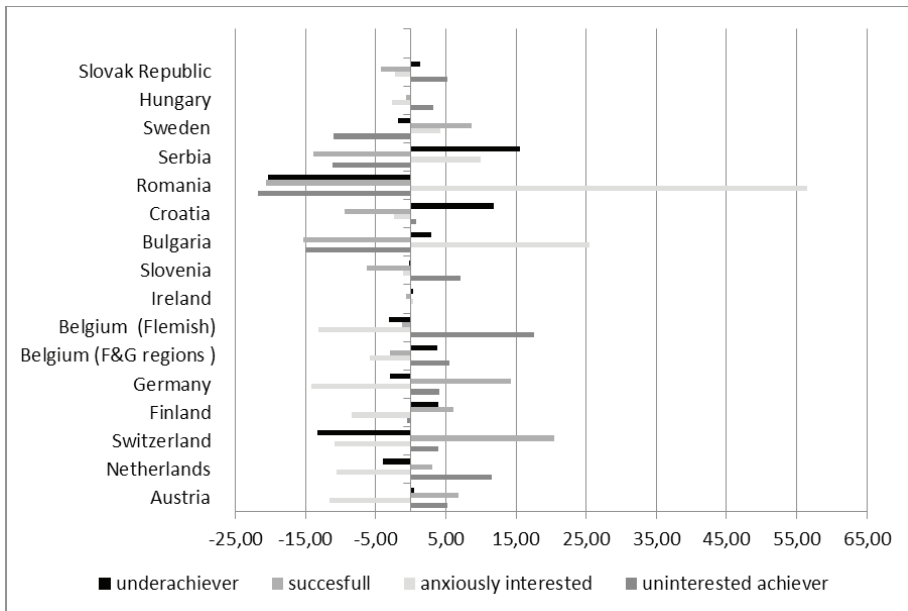


Figure 2. Overview of cluster membership across countries

Note. Horizontal axis depicts standard residual values. Absolute value of 1.9 is treated as a significant one.

In countries characterized by low achievement in mathematics and high anxiety at the country level (i.e. Bulgaria, Croatia, Romania, and Serbia) we observed the ‘*successful group*’ to be under-represented, together with the ‘*uninterested achiever*’ group in Bulgaria, Romania and Serbia. Furthermore, in these three countries we also found significantly more students belonging to the ‘*anxiously interested*’ group (please see Figure 2 for details).

### Who are the successful students in mathematics?

Further analyses have focused our attention to the ‘*successful group*’, that is students who show optimal patterns of mathematics self-related beliefs, low anxiety and achieve high scores at PISA mathematics test. Having these patterns in mind, we could see that this group was present across the European countries observed in the study, and the observation has prompted us to examine what are the similarities and differences in the factors relevant for students’ success in mathematics.

Among all the examined predictors only ESCS (odds ratio values were in range from 1.281 to 2.217) and experience with pure mathematics tasks (odds ratio values were from 1.302 to 1.625) were significant predictors for all countries. The *disciplinary climate* contributed students’ odds of belonging to the ‘*successful group*’ (from 1.184 in Finland to 1.474 in Croatia) for all countries

except Belgium and the Netherlands. *Subjective norms in mathematics* (odds ratios were in the range from 1.158 in Croatia to 1.785 in Hungary), i.e., the extent to which a student's social environment promotes mathematics and the study of mathematics (OECD, 2013b), was significant for all countries except for Romania and Sweden. *Teacher support* was also a significant predictor through a variety of countries (except Belgium and Bulgaria). In all of these cases (i.e., ESCS, experience with pure mathematics tasks, disciplinary climate, subjective norms, teacher support) an increase in the parameter value has augmented students' chances to belong to the 'successful group'.

Although significant across all of the countries (except the Belgium-Flemish community), the existence of *student-oriented teacher practices* lowered student chances to succeed in mathematics.

Table 3  
Predictors of succeeding in mathematics (by country)

Country	CLS MAN	COGACT	DISCLMA	ESCS	EXAPPLM	MTSUP	STUDREL	SUBNORM	TCHBEHFA	TCHBEHSD	TCHBEHSSO	TCHBEHTD	TEACHSUP	EXPUREM
Austria	Estim. -0.043	0.080	0.142**	0.447**	0.181**	0.010	0.077*	0.269**	0.125*	-0.288**	-0.068	0.294**	0.312**	
	S.E. 0.048	0.057	0.049	0.047	0.046	0.053	0.037	0.037	0.056	0.053	0.059	0.053	0.063	
	OR 0.958	1.084	1.153	1.564	1.199	1.010	1.080	1.308	1.133	0.750	0.935	1.341	1.367	
Belgium	Estim. 0.106*	0.154**	0.126*	0.286*	0.050	-0.029	0.138**	0.344**	-0.020	-0.092	0.010	0.241**	0.425**	
	S.E. 0.055	0.053	0.051	0.049	0.052	0.61	0.053	0.055	0.055	0.061	0.058	0.055	0.047	
Flemish	OR 1.123	1.167	1.134	1.332	1.051	0.971	1.148	1.410	0.980	0.912	1.010	1.272	1.530	
Belgium - other	Estim. 0.133*	0.105	0.106	0.495**	0.149**	0.127*	-0.002	0.214**	0.033	-0.169**	0.034	0.051	0.360*	
	S.E. 0.059	0.069	0.056	0.062	0.046	0.064	0.055	0.060	0.073	0.058	0.073	0.066	0.052	
	OR 1.142	1.110	1.112	1.641	1.160	1.135	0.998	1.238	1.034	0.844	1.035	1.052	1.433	
Bulgaria	Estim. 0.231**	0.141*	0.345**	0.796**	-0.068	0.160**	0.120*	0.188**	-0.052	-0.262**	0.124	0.031	0.407**	
	S.E. 0.059	0.064	0.066	0.052	0.053	0.062	0.050	0.039	0.070	0.057	0.071	0.059	0.056	
	OR 1.260	1.151	1.412	2.217	0.934	1.173	1.128	1.207	0.949	0.769	1.133	1.031	1.502	
Croatia	Estim. 0.035	0.060	0.386**	0.516**	0.255**	0.025	0.056	0.147**	0.061	-0.235**	0.054	0.270**	0.313**	
	S.E. 0.064	0.074	0.055	0.059	0.043	0.052	0.051	0.051	0.080	0.047	0.069	0.074	0.067	
	OR 1.036	1.062	1.471	1.676	1.291	1.025	1.058	1.158	1.063	0.791	1.056	1.110	1.367	
Finland	Estim. 0.092	-0.046	0.126**	0.409**	0.324**	-0.036	0.177*	0.340**	-0.151**	0.109*	0.178**	0.349**	0.463**	
	S.E. 0.060	0.054	0.048	0.045	0.040	0.061	0.043	0.039	0.046	0.046	0.057	0.057	0.049	
	OR 1.097	0.955	1.134	1.506	1.383	0.956	1.124	1.404	0.860	0.897	1.194	1.418	1.589	
German.	Estim. 0.006	0.251**	0.226**	0.367**	-0.094*	0.013	0.083**	0.148**	0.078	-0.149**	-0.074	0.212**	0.377**	
	S.E. 0.041	0.059	0.045	0.039	0.039	0.052	0.031	0.032	0.051	0.043	0.054	0.053	0.042	
	OR 1.006	1.286	1.254	1.443	0.910	1.013	1.087	1.159	0.881	0.861	0.928	1.236	1.457	
Hungary	Estim. 0.023	0.016	0.202**	0.627**	0.044	0.032	-0.023	0.579**	-0.095	-0.293**	-0.082	0.351**	0.345**	
	S.E. 0.054	0.069	0.050	0.048	0.040	0.062	0.051	0.049	0.070	0.054	0.069	0.064	0.058	
	OR 1.023	1.016	1.224	1.872	1.045	1.032	0.977	1.785	0.909	0.746	0.922	1.421	1.413	
Ireland	Estim. 0.072	0.114*	0.250**	0.473**	0.128**	-0.046	0.113**	0.268**	-0.062	-0.123*	-0.036	0.170**	0.422**	
	S.E. 0.055	0.051	0.053	0.049	0.051	0.056	0.046	0.046	0.053	0.047	0.061	0.054	0.050	
	OR 1.075	1.121	1.284	1.605	1.136	0.955	1.110	1.307	0.939	0.885	0.965	1.185	1.526	
Netherl.	Estim. 0.055	-0.052	0.106	0.308**	-0.177**	0.046	0.033	0.514**	-0.149*	-0.121*	0.063	0.308**	0.396**	
	S.E. 0.065	0.056	0.066	0.060	0.053	0.071	0.053	0.053	0.066	0.064	0.064	0.073	0.053	
	OR 1.056	0.950	1.112	1.360	0.838	1.047	1.033	1.672	0.862	0.886	1.065	1.361	1.486	
Norway	Estim. -0.019	0.121*	0.195**	0.512**	0.040	0.010	0.132**	0.339**	0.172**	-0.185**	-0.269**	0.464**	0.361**	
	S.E. 0.056	0.059	0.054	0.060	0.047	0.058	0.042	0.047	0.063	0.058	0.068	0.064	0.051	
	OR 0.981	1.129	1.215	1.668	1.041	1.010	1.141	1.403	1.188	0.831	0.764	1.591	1.434	
Roman.	Estim. 0.000	0.107	0.352**	0.172**	0.072	-0.034	0.224**	0.034	0.207**	-0.357**	-0.032	0.086	0.299**	
	S.E. 0.081	0.083	0.065	0.083	0.047	0.075	0.069	0.062	0.079	0.072	0.071	0.065	0.080	
	OR 1.000	1.113	1.421	3.230	1.075	0.967	1.251	1.034	1.230	0.700	0.968	1.090	1.349	

Note: OR – Odds Ratio, \*\* parameter significant at 0.01 level, \* parameter significant at 0.05 level

Table 3  
(continued)

Country	CLSMAN	COGACT	DISCLIMA	ESCS	EXAPPLM	MTSUP	STUDREL	SUBNORM	TCHBEHFA	TCHBEHSA	TCHBEHTD	TEACHSUP	EXPUREM
Serbia	Estim.	-0.002	0.149*	0.243**	0.599**	0.016	0.066	0.082	0.054	-0.360**	-0.046	0.237**	0.466**
	S.E.	0.055	0.070	0.047	0.063	0.053	0.062	0.058	0.068	0.061	0.068	0.062	0.070
	OR	0.988	1.161	1.275	1.821	1.016	1.068	1.086	1.237	1.055	0.697	1.268	1.593
Slovak Repub.	Estim.	-0.051	0.182*	0.213**	0.626**	-0.097	0.242**	0.046	-0.139*	-0.205**	-0.103	0.254**	0.485**
	S.E.	0.065	0.073	0.055	0.055	0.050	0.059	0.053	0.060	0.055	0.065	0.062	0.060
	OR	0.950	1.199	1.237	1.869	0.907	1.274	1.047	0.870	0.814	0.902	1.289	1.625
Slovenia	Estim.	0.032	0.213**	0.284**	0.448**	0.056	-0.037	0.139*	0.001	-0.187**	0.044	0.209**	0.289**
	S.E.	0.058	0.063	0.048	0.061	0.042	0.056	0.059	0.066	0.046	0.061	0.058	0.058
	OR	1.033	1.237	1.329	1.566	1.058	0.964	1.149	1.300	1.001	1.045	1.233	1.335
Sweden	Estim.	0.074	0.274**	0.136**	0.582**	0.078*	0.090	0.116**	0.074	-0.214**	-0.158**	0.190**	0.370**
	S.E.	0.056	0.048	0.050	0.047	0.038	0.052	0.041	0.039	0.051	0.057	0.050	0.047
	OR	1.077	1.316	1.146	1.789	1.082	1.094	1.123	0.992	1.076	0.807	1.209	1.377
Switzer.	Estim.	0.021	0.194**	0.184**	0.248**	0.056	-0.092*	0.085*	0.018	-0.172**	-0.109*	0.233**	0.264**
	S.E.	0.041	0.046	0.037	0.034	0.040	0.043	0.035	0.043	0.040	0.048	0.045	0.034
	OR	1.021	1.214	1.202	1.281	1.058	0.912	1.089	1.018	0.842	0.896	1.250	1.302

All other predictors (classroom management, mathematics teacher support, and teacher directed instruction) were significant in less than half of the examined countries.

Finally, when observing the particular contribution of examined predictors relative to country groups, we recognized some distinctive patterns (please see Figure 1). For the countries with the score in mathematics achievement below the OECD average *disciplinary climate* and *student-oriented teacher practice* were significant predictors. As discussed earlier, while existence of *disciplinary climate* increased odds for a student to succeed in mathematics, it lowered them as the unit of *student-oriented teacher practice* increased. In addition to this, in the Slovak Republic, Sweden and Hungary (i.e., countries with below the average mathematics achievement and mathematics anxiety that is lower than the OECD average) the existence of *teacher support* also increased the odds for students belonging to the 'successful group'.

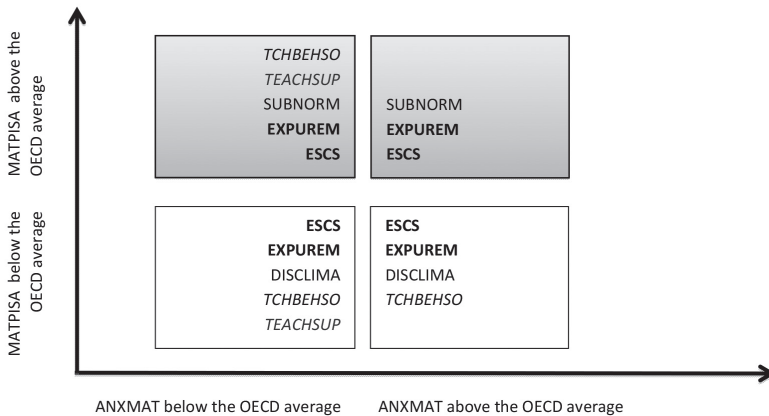


Figure 3. Overview of significant predictors by country groups for students succeeding in mathematics

In contrast to this, when we observed countries whose average achievement in PISA mathematics test was above the OECD average, students' odds to succeed in mathematics were increased with introducing *subjective norms in mathematics*. Again, in addition to this, in Germany, the Netherlands, Austria, Switzerland and Finland (i.e., countries where mathematics anxiety levels were below the OECD average) *student-oriented teacher practices* and *teacher support* were also significant predictors. While in case of the latter an increase in the unit value increased students' odds to succeed in mathematics; for the former we had observed a reverse pattern.

Finally, when observing all countries with mathematics anxiety levels below the OECD average, against those where these levels were above the OECD

average the difference was in the *teacher support* as a distinctive significant predictor for the former group. Its existence, that is an increase in the unit value, contributed to students' being in the '*successful group*'.

## Discussion

The results of the study confirm that it is possible to identify student subgroups when examining their self-related beliefs in mathematics, intrinsic interest in the domain and achievement. Across the European countries four groups were identified (*uninterested achiever, successful group, anxiously interested and underachievers*). All four profiles were visible in each of the countries we have examined, which favours the generalizability of the results. The structure of the extracted groups also mirrors previous findings on the relationship between achievement in mathematics, self-concept and mathematics anxiety (e.g., Chang & Beilock, 2016; Hwang et al., 2016; Ma, 1999; Stankov & Lee, 2017). Thus, students belonging to a successful profile perceive their own interest and self-related beliefs as high, coupled with highest mathematics scores. The opposite pattern was presented in the '*unsuccessful*' group.

But, except the '*successful*' and '*underachiever*' groups, anticipated by the first hypothesis, two more groups were extracted with more complex distinguishing patterns relative to the relationship between the variables. This result implies that empirically well-established relationship between high achievement, high self-concept and low mathematics anxiety does not mirror patterns relevant to all students. Accordingly, education interventions should be planned considering the diversity between these groups.

The occurrence of the extracted groups could be linked with the average country score in mathematics and the average anxiety at the country level (OECD, 2013b) which is in accordance with our anticipation (hypothesis two). High achieving countries have more students in high achievement groups. Particular patterns were especially visible when contrasting '*successful*' against '*unsuccessful*' countries in PISA. In general, this finding implies that particular underlying practices in these countries do exist and are relevant to how teaching and learning around mathematics is organized, thus accounting for more students belonging to the '*successful profile*' or those students who exhibit anxiety towards mathematics.

This picture is further developed and clarified by examining the predictors contributing students' success in mathematics in regard to the country differences. The analysis enables insight in both generalized as well as country specific implications. Across the countries ESCS and pure mathematics experience remain predictors relevant for all, in increasing students' odds of belonging to the '*successful*' profile. This result is in line with the results examining the general relationship between student achievement, ESCS and being exposed to pure mathematics (Baucal, 2012; Gustafsson et al., 2013; OECD, 2013b; Schmidt & Burroughs, 2015). Furthermore, the result also implies that putting efforts in reducing ESCS gaps between students should be part of the educational strategy

regardless of the country background. Increasing students' experience with pure mathematic tasks could be considered as a strategy for all countries. At the same time, it is important not to reduce the opportunity for the students to grapple with real life mathematics problems (Pekrun et al., 2007b; Vorhölter, Kaiser, & Borromeo Ferri, 2014).

On the other hand, in the three out of four analysed country' groups, student-oriented teacher instruction lowers students' chances of belonging to the successful profile. Although this construct implies differentiated instruction (OECD, 2014), we may assume that for lower achieving students 'working in small groups' or 'projects that require at least one week to complete' may trigger students' low self-efficacy and concepts of their own competence, thus hindering their participation. Conversely, to further understand the negative contribution of this predictor in low achieving countries between-school variance may be of particular importance here, as well as how these practices are enacted between schools. Hence, although student-oriented teacher instruction is perceived to be more interesting, enjoyable and valuable than the teacher-centred approaches with better long-term learning outcomes (Black & Deci, 2000; Greeno, Collins, & Resnick, 1996; Sturm & Bogner, 2008) the introduction of this paradigm in classrooms, without careful analysis of the obstacles in the implementation process, could actually be counterproductive.

Our findings are in line with the previous results on the relative contribution of disciplinary climate to students' achievement (Stankov & Lee, 2017). This factor more consistently contributes students' odds in belonging to a successful profile in the countries with an average achievement score that is below the OECD average regardless of the position country holds regarding the index of math anxiety. In almost all of the countries from these two groups, indexes of disciplinary climate are lower than the OECD average (OECD, 2013a), indicating that, improving disciplinary climate is of particular importance for countries struggling in this domain, especially when coupled with lower achievement at the country level.

From other school factors, teacher support seems to be relevant in contributing students being placed in the '*successful*' profile, especially in countries with lower than OECD average scores in mathematics anxiety. Although this predictor is more clearly linked with students' sense of belonging to school than achievement and self-beliefs (OECD, 2013b), we may postulate that these countries have been able to develop mechanisms that contribute overall to student school wellbeing, and thus indirectly to tackle possible anxieties in the school environment. In addition, addressing attention to raising teacher support together with other aspects of the school climate may be more effective as part of an intervention programme focusing on increasing achievement, than when addressing one aspect at the time.

However, what remains to be further investigated is the absence of a clear relationship across the countries between students who succeed in mathematics



and the relationship with the mathematics teacher alone. In connection to that, more positive social norms towards mathematics in high achieving countries are clearly linked with students' success in mathematics, implying the importance of both home (the parents) and social counterparts (peers) in explaining what brings a child closer to success.

## Conclusions

The focus of this study was on identifying subgroups of students with different patterns in mathematics achievement, mathematics anxiety and mathematics related self-beliefs, focusing on the cross-country perspective. Following from this, we wished to determine the factors differentiating students with the optimal pattern of high mathematics achievement and positive self-related mathematics beliefs.

Our findings reveal that, across European countries, the patterns of relationships between investigated variables could be described by four students' groups (*uninterested achiever*, *successful group*, *anxiously interested and underachievers*). The general implication of the study is that, in order to have more students in the '*successful*' group, some level of country specific interventions is necessary. This finding, when applied to all European countries in the focus of this study, implies that reducing socioeconomic inequalities and introducing more pure mathematics tasks increases the chances for students to belong to the '*successful*' group. Beyond that, all other intervention aspects need to be planned relative to a country's background specifics.

## Limitations and Further Research

This is a cross-sectional study and, as such, it does not allow us to examine the stability of extracted student groups over time. The PISA cycle in 2021 will focus again in mathematics and, to an extent; we will be able to explore the idea further. However, the current results and data do allow us to plan further investigation in two possible directions.

Firstly, it is possible to examine predictors for the other three student profiles and to compare how each predictor decreases or increases the odds for students to belong to the specific profile. Secondly, we are able to examine whether predictors, significant at student level, are also significant at school level, relative to both particular country and country group(s). Such analyses would allow us to portray a more complex story of factors contributing students' success in mathematics and to deepen understanding of different policies and practices across countries relevant to facilitating students' success in mathematics.

## References

- Ahmed, W., van der Werf, G., Kuyper, H., & Minnaert, A. (2013). Emotions, self-regulated learning, and achievement in mathematics: A growth curve analysis. *Journal of Educational Psychology, 105*(1), 150–161. <http://dx.doi.org/10.1037/a0030160>
- Artemenko, C., Daroczy, C., & Nuerk, H. C. (2015). Neural correlates of math anxiety an overview and implications. *Frontiers in Psychology, 6*, 1333. <http://dx.doi.org/10.3389/fpsyg.2015.01333>
- Ashcraft, M.H., & Ridley, K.S. (2005). Math anxiety and its cognitive consequences: A tutorial review. In J. I. D. Campbell (Ed.), *Handbook of Mathematical Cognition* (pp. 315–327). New York: Psychology Press.
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology, 52*(1), 1–26.
- Baucal, A. (2012). Uticaj socio-ekonomskog statusa učenika na obrazovna postignuća: Direktni i indirektni uticaji. *Primenjena psihologija, 1*, 5–24.
- Black, A. E., & Deci, E. L. (2000). The effects of instructors' autonomy support and students' autonomous motivation on learning organic chemistry: A self-determination theory perspective. *Science education, 84*(6), 740–756.
- Chang, H., & Beilock, S. L. (2016). The math anxiety-math performance link and its relation to individual and environmental factors: a review of current behavioral and psychophysiological research. *Current Opinion in Behavioral Sciences, 10*, 33–38. doi.org/10.1016/j.cobeha.2016.04.011
- Field, A. (2013). *Discovering Statistics Using IBM SPSS Statistics*. London, England: SAGE.
- Graham, J.W. (2012). *Missing Data: Analysis and Design*, Statistics for Social and Behavioral Sciences, Springer. doi:10.1007/978-1-4614-4018-5\_2
- Greeno, J. G., Collins, A.M., & Resnick, L.B. (1996). Cognition and learning. In R. C. Calfee (Ed.), *Handbook of Educational Psychology* (pp. 15–46). New York: Macmillan Library Reference.
- Gustafsson, J., Hansen, Y. K., & Rosen, M. (2013). Effects of home background on student achievement in reading, mathematics, and science at the fourth grade. In M. O. Martin & I. V. S. Mullis (Eds.), *TIMSS and PIRLS 2011: Relationships among reading, mathematics, and science achievement at the fourth grade — implications for early learning* (pp. 183–289) Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College.
- Hembree, R. (1990). The nature, effects, and relief of math anxiety. *Journal for Research in Mathematics Education, 21*, 33–46. doi:10.2307/749455
- Hwang, M. H., Choi, H. C., Lee, A., Culver, J. D., & Hutchison, B. (2016). The Relationship Between Self-Efficacy and Academic Achievement: A 5-Year Panel Analysis. *The Asia-Pacific Education Researcher, 25*(1), 89–98. doi:10.1007/s40299-015-0236-3
- Kazelskis, R., Reeves, C., Kersh, M., Bailey, G., Cole, K., Larmon, M., Holliday, D. (2000). Mathematics Anxiety and Test Anxiety: Separate Constructs? *The Journal of Experimental Education, 68*(2), 137–146. Retrieved from <http://www.jstor.org/stable/20152623>
- Komarraju, M., & Nadler, D. (2013). Self-efficacy and academic achievement: why do implicit beliefs, goals, and effort regulation matter? *Learning and Individual Differences, 25*(1), 67–72. doi.org/10.1016/j.lindif.2013.01.005
- Lauermann, F., Eccles, J. S., & Pekrun, R. (2017). Why do children worry about their academic achievement? An expectancy-value perspective on elementary students' worries about their mathematics and reading performance. *ZDM Mathematics Education, 1*–16. doi:10.1007/s11858-017-0832-1
- Lee, J. (2009). Universals and specifics of math self-concept, math self-efficacy, and math anxiety across 41 PISA 2003 participating countries. *Learning and Individual Differences, 19*, 355–365. doi:10.1016/j.lindif.2008.10.009

- Liou, P.-Y. (2017). Profiles of adolescents' motivational beliefs in science learning and science achievement in 26 countries: Results from TIMSS 2011 data. *International Journal of Educational Research*, 81, 83–96. doi.org/10.1016/j.ijer.2016.11.006
- Ma, X. (1999). A meta-analysis of the relationship between anxiety toward mathematics and achievement in mathematics. *Journal for Research in Mathematics Education*, 30(5), 520–540. doi:10.2307/749772
- Ma, X., & Xu, J. M. (2004). The causal ordering of mathematics anxiety and mathematics achievement: a longitudinal panel analysis. *Journal of Adolescence*, 27(2), 165–179.
- Marsh, H. W. (2007). *Self-concept theory, measurement and research into practice: The role of self-concept in educational psychology*. Leicester, UK: British Psychological Society.
- Marsh, H. W., Lüdtke, O., Nagengast, B., Trautwein, U., Abduljabbar, A. S., Abdelfattah, F., & Jansen, M. (2015). Dimensional Comparison Theory: Paradoxical relations between self-beliefs and achievements in multiple domains. *Learning and Instruction*, 35, 16–32. doi.org/10.1016/j.learninstruc.2014.08.005
- Marsh, H. W., Xu, M. K., & Martin, A. J. (2012). Self-concept: a synergy of theory, method, and application. In K. R. Harris, S. Graham, & T. C. Urdan (Eds.), *APA Educational Psychology Handbook. Volume 1, Theories, Constructs, and Critical Issues* (pp. 427–458) Washington D.C.: American Psychological Association
- Muthén, L. K., & Muthén, B. (1998–2013). *Mplus user's guide (7th ed.)*. Los Angeles, CA: Muthén & Muthén.
- Nuñez-Pena, M. I. Suarez-Pellicioni, M., & Bono, R. (2013). Effects of math anxiety on student success in higher education. *International Journal of Educational Research*, 58, 36–43. doi.org/10.1016/j.ijer.2012.12.004
- OECD (2013a). *PISA 2012 Results: What Makes Schools Successful (Volume IV): Resources, Policies and Practices*, Paris: OECD Publishing.
- OECD (2013b). *PISA 2012 Results: Ready to Learn – Students' Engagement, Drive and Self-Beliefs (Volume III)*, Paris: OECD Publishing.
- OECD (2014). *PISA 2012 Technical Report*. Paris: OECD Publishing.
- Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review*, 18, 315–341.
- Pekrun, R., Frenzel, A. C., Goetz, T., & Perry, R. P. (2007a). The Control-Value Theory of achievement Emotions: An Integrative Approach to Emotions in Education. In P. A. Schutz & R. Pekrun (Eds.), *Emotions in Education* (pp. 13–37). London: Academic Press.
- Pekrun, R., Vom Hofe, R., Blum, W., Frenzel, A. C., Goetz, T., & Wartha, S. (2007b). Development of Mathematical Competencies in Adolescence: The PALMA Longitudinal Study. In M. Prenzel (Ed.), *Studies on the educational quality of schools. The final report on the DFG Priority Programme* (pp. 17–37). Münster, Germany: Waxmann.
- Pintrich, P. R. (2000). The role of goal-orientation in self-regulated learning. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 452–502). San Diego: Academic Press.
- Robbins, S. B., Lauver, K., Le, H., Davis, D., Langley, R., & Carlstrom, A. (2004). Do psychosocial and study skill factors predict college outcomes? *Psychological Bulletin*, 130(2), 261–288. doi:10.1037/0033-2909.130.2.261
- Scheerens, J., & R. Bosker (1997), *The Foundations of Educational Effectiveness*, Oxford: Pergamon Press.
- Schiefele, U. (2009). Situational and individual interest, In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 197–222) New York/London: Routledge.
- Schmidt, W. H., & Burroughs, N. A. (2015). Puzzling Out PISA: What Can International Comparisons Tell Us about American Education? *American Educator*, 39(1), 24–31.

- Schunk, D. H., & Pajares, F. (2009). Self-efficacy theory. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation at school* (pp. 35–53). New York: Routledge.
- Schütte, K. (2015). Science self-concept and valuing science: a cross-cultural analysis of their relation among students from Western and East Asian countries. *Social Psychology of Education, 18*(4), 635–652. doi:10.1007/s11218–015–9311-0
- Seidel, T., & Shavelson, R. J. (2007). Teaching effectiveness research in the past decade: The role of theory and research design in disentangling meta-analysis results. *Review of educational research, 77*(4), 454–499.
- Skaalvik, E. M., Federici, R. A., & Klassen, R. M. (2015). *Mathematics achievement and self-efficacy: Relations with motivation for mathematics. International Journal of Educational Research, 72*, 129–136. doi:10.1016/j.ijer.2015.06.008
- Stankov, L., & Lee, J. (2017). Self-beliefs: Strong correlates of mathematics achievement and intelligence. *Intelligence, 61*, 11–16. doi.org/10.1016/j.intell.2016.12.001
- Sturm, H., & Bogner, F. X. (2008). Student-oriented versus Teacher-centred: The effect of learning at workstations about birds and bird flight on cognitive achievement and motivation. *International Journal of Science Education, 30*(7), 941–959.
- Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics* (5th ed.). Boston: Pearson Education.
- Viljaranta, J., Tolvanen, A., Aunola, K., & Nurmi, J.-E. (2014). The Developmental Dynamics between Interest, Self-concept of Ability, and Academic Performance. *Scandinavian Journal of Educational Research, 58*(6), 734–756. doi:10.1080/00313831.2014.904419
- Vorhölter K., Kaiser G., & Borromeo Ferri, R. (2014). Modelling in Mathematics Classroom Instruction: An Innovative Approach for Transforming Mathematics Education. In: Y. Li, E. Silver, & S. Li (Eds.), *Transforming Mathematics Instruction. Advances in Mathematics Education* (pp. 21–36). Cham: Springer.
- Wigfield, A., & Eccles, J. S. (2000). Expectancy-value theory of motivation. *Contemporary Educational Psychology, 25*, 68–81.
- Wigfield, A., Tonks, S., & Klauda, S. L. (2009). Expectancy-value theory. In K. R. Wentzel & A. Wigfield (Eds.), *Handbook of motivation in school* (pp. 55–76). New York: Taylor Francis.
- Zeidner, M. & Matthews, G. (2011). *Anxiety 101*. New York: Springer.

## Издајање студената успешних у математици - Поређење између европских земаља

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У овој студији истраживани су фактори који издајају ученике са оптималном шемом високог постигнућа у математици и позитивна веровања ових ученика о математици у 17 европских региона користећи податке из PISA-е 2012. У ову сврху примењена је хијерархијска кластер анализа варијабли математичке анксиозности, постигнућа ученика и перцепције математичке ефикасности ученика, математичког селф-концепта и интринзичке мотивације. На овај начин добијене су четири различите групе ученика. Међу

њима је био и профил ученика успешних у математици (ниска математичка анксиозност, висока мотивација и високи опажена математичка ефикасност, селф-концепт и интринзичка мотивација). Резултати показују разлике у факторима који су битни за успех ученика у математици у зависности од тога да ли су скорови математичке писмености и математичке анксиозности изнад или испод просека ОЕБСа. Социоекономско и културно порекло ученика, као и искуство са чистим математичким задацима су фактори који су битни у свим испитиваним земљама.

Кључне речи: *PISA, математика, успешни ученици.*

RECEIVED 22.05.2017.

REVISION RECEIVED 02.02.2018.

ACCEPTED 07.02.2018.

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