The Predictive Power of Attribution Styles for PISA 2012 Achievement: International and National Perspective

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Introduction

In the paper, Weiner's attribution theory is used as a framework in explaining the differences between high and low achieving students in PISA 2012 study for international and national analyses.

The reasons people give for why they succeeded or failed a task are called attributions. (Heider, 1958, in Nokelainen, Tirri and Merenti-Välimaki, 2007). Furthermore, attribution theory has been widely recognized as a significant contributor in achievement explaining models (Stroud and Reynolds, 2009). According to Dembo and Eaton (1996, in Stroud and Reynolds, 2009), motivation is constructed from three internal factors, one of them being the students' attributions for success and failure (the other two are: the importance placed on the task and the emotional process associated with the learning process). Weiner (1985; 2010) defined attributions more precisely. He distinguished attributions on three dimensions: locus (whether the cause is internal or external), controllability (whether the cause can be subjected to volitional influence) and stability (whether the cause is stable or varies over time). He also identified four common attributions that differ on these dimensions: effort (internal, controllable and unstable), ability (internal, uncontrollable and stable), task difficulty (external, uncontrollable, stable) and luck (external, uncontrollable, and unstable). Additionally, attribution constructs can be classified into three groups: attribution appraisals (explanations assessed following actual or manipulated success or failure in performing a specific task), attribution beliefs (domain specific or domain general beliefs about the causes of success or failure), attribution styles (generalized, stereotypical patterns of attributions and dispositional beliefs) (Dai, Moon and Feldhusen, 1998, in Nokelainen et al., 2007).

The specific attributions that students make affect their expectancy for future performance, persistence in similar tasks, emotional responses, which tasks they choose, and self-efficacy, which is an important characteristic for educational setting (Demo and Eaton, 1996, in Stroud and Reynolds, 2009). Students with an internal locus of control believe that events in life are controlled by their own actions, whereas those with an external locus of control attribute the outcomes of events to outside factors such as luck. In general, people with an external locus of control appear to be prone to a variety of symptoms of stress including emotional distress, job dissatisfaction, burn-out and low self-esteem (Matthews, Deary and Whiteman, 2009). On one hand, students with attributions showing the internal locus of control (e.g. effort) will work harder to improve themselves in school. In addition to this, those students who attribute their success or failure to external factors (e.g. parents, friends, teachers...) tend not to invest more time in learning.

The motivational path of causal attribution begins with the interpretation of the event (in our case the mathematics achievement) as success or failure. Following the initial reaction of happiness or sadness, individuals search the reason why this specific outcome has occurred. In the achievement domain, successes and failures are often attributed to an ability factor, an effort factor, the difficulty of the task, luck, mood and help or hindrance from others. When explaining achievement results, individuals attach the most importance to their perceived competences and how hard they tried. The attribution theory proposes that people spontaneously engage in such causal thinking in their everyday lives (Graham and Williams, 2009).

Studies broadly investigated the relationship between attribution styles and academic achievement (Gibb et al., 2002) stating a significant relationship and significant predictive value of the locus of control for academic achievement (Gibb et al., 2002; Philips and Gully, 1997), study time and effort (Shell and Husman, 2008). For instance McClure, Meyer, Garisch, Fischer, Weir and Walkey (2011) examined the relationship between attributions for success and failure and academic achievement among students aged 14 and 15 years (as in PISA study). They also measured motivation orientations and cultural differences; therefore European, Asian, Maori and Pacific participants were included in the research. The measure assessed attributions (causes for their best and worst performance only), motivation orientation (doing my best and doing just enough scales), demographic data and achievement data. The results firstly confirmed the self-serving bias, which was already proven in many previous studies (e.g. Bong, 2004; Vispoel and Austin, 1995). Students show a self-serving pattern of attributing their highest marks to effort and ability more than their lowest marks, which are mostly attributed to task difficulty. Students who attributed their best marks to internal factors of ability and effort attained higher achievement. On the other hand, students who attributed their best marks to luck, family and friends gained lower achievement scores. Moreover, attributions for their worst marks were also important. Students who attributed their worst marks to ability, effort, high task difficulty and the influence of teachers gained higher achievement scores, whereas students who attributed their worst marks to family and friends gained lower achievement scores. In addition, the regression analyses showed that the students' motivation orientation and attributions is a significant predictor of achievement, accounting for 38 % of the students' achievement scores. Among attributions the strongest positive predictor was attributing the best marks to effort and the worst marks to lack of effort and to the influence or characteristics of the teacher, while the main negative predictors were attributing the best or worst marks to family and friends and attributing the best marks to luck.

Similar patterns were established in primary school students. Khodayarifard, Brinthaupt and Anshel (2010) examined the relationships between academic achievement and the child's and the parent's attribution styles in primary school students and their parents. Regarding the connection between attributions and academic achievement, the results were consistent with previous research (Carr et.al. 1991; Stipek and Hoffman, 1988). Students who did not perform well academically tended to show a more negative attributional style (attributing negative events to more stable and uncontrollable causes).

Longitudinal effects were tested in Liu, Cheng, Chen and Wu (2009) study. They examined the longitudinal effect of educational expectations and achievement attributions on adolescents' academic achievement (secondary school students). The results show that high educational expectations and attribution to effort (controllable, unstable attribution) have a positive effect on learning growth rate, while attributions to others have a negative effect on the learning growth rate. Furthermore, as already proven in previous research (e.g. Georgiou, 1999), attributions of achievements to effort are positively related to actual achievements, whereas attributions to others are negatively related to achievement. The pattern of perceived control is associated with better self-regulation, knowledge building, question asking, study use and effort (Shell and Husman, 2008). The study showed that such attributional patterns influence the long-term academic development of adolescents (Schunk, 1992).

The relationship between attribution styles and academic achievement can be explained using the concept of self-regulation. According to social-cognitive theory, self-regulation is dependent on the situation and it is not stable. Based on this assumption, Zimmerman (2000) describes self-regulation as cyclical with three phases containing sub processes: forethought (task analyses and self-motivation beliefs), performance (self-control and self-observation), and self-reflection (self-judgement (e.g. self-evaluation and causal attribution) and self-reaction (e.g. self-satisfaction)). According to their performance in each of these domains, learners have been described as skilled or unskilled learners (Stroud & Reynolds, 2009). Attributions are a part of the final stage. Self-reflection begins with self-judgement (individual comparisons of information gained through self-monitoring to extrinsic standards or goals). An individual is motivated to have fast and accurate feedback on his or hers performance as compared to others. Self-judgement leads to attribution interpretations where the learner interprets the reasons for success and failure. Attribution interpretations can lead to positive self-reactions. The individual might interpret their failure as the result of too little effort and then increase his or hers efforts. On the other hand, if they interpret their failure as a lack of ability the reaction is likely to be decreased in learning behaviour. Attribution interpretations reveal the possible reasons for learning mistakes and help the learner to find the most appropriate learning strategies. Additionally, they also promote adaptation and self-regulation, which eventually leads to a more positive self-image and enhance intrinsic interest in the task (Nokelainen et al., 2007). Ellström (2001, in Nokelainen et al., 2007) goes even beyond that stating that attributions for success and failure affect potential competence.

Attribution style has been shown in some studies to alter according to the context (Sarafino, 2006, in Graham and Williams, 2009). Therefore the focus of this paper is mainly on the educational setting and on mathematical achievement. The paper concentrates specifically on PISA 2012 results and the predictive value of attribution styles on PISA 2012 mathematics achievement. PISA measures attribution styles in the context of the students' drive and motivation in the form of separate questions in the students' background questionnaire. PISA measures drive and motivation using four concepts: perseverance (constructed index based on the students' responses about their willingness to work on problems that are difficult, even when they encounter problems), openness to problem solving (constructed index based on the students' responses about their willingness to engage with problems), locus of control/attribution style (constructed index based on the students' responses about whether they attribute failure in mathematics test to themselves or to others; and the students responses about whether they strongly agree that success in mathematics and school depends on whether they put in enough effort) and motivation to learn mathematics – intrinsic and instrumental (constructed indices based on the students' responses about whether they enjoy mathematics and work hard in mathematics because they enjoy the subject, and whether they believe mathematics is important for their future studies and careers) (OECD, 2013b). In line with the attribution theory, PISA measures attributions on all three dimensions (locus, control, stability). Exposing individuals to academic success or failure and then asking them to report about their feelings and thoughts can measure attribution styles. The other possibility is to design a set of items where individuals imagine success or failure and then self-report what their most likely thoughts would be as is the case in the PISA study.

The present study aims to:

(1) Identify the attribution for success question set structure on an international level: All constructs that measure drive and motivation in PISA are developed in a form of indices on an international level except the question set measuring attribution for success (the students' responses about whether they strongly agree that success in mathematics and school depends on whether they put in enough effort) therefore the first aim of this study is to analyse the structure of this question set at the international level in order to construct an index that could be used as predictors in second aim of the study.

(2) Analyse predictive power of the attribution for success in mathematics for mathematics achievement on an international and national (Slovenia) level. The second aim of the study therefore is to use the newly developed index (indices) as a predicting variable in a regression model for mathematics achievement on an international level. Our basic assumption in line with the theoretical framework is that an internal locus of control predicts higher achievement on an international and national level. To test the generalizability of our findings we will use the same regression model on an international level (PISA 2012 international data base) on national level (Slovene PISA 2012 data base) and additionally in selected EU member states with different average mathematics achievement score. The choice was made based on average students' mathematics achievement score (as presented in international reports), where Netherlands and Estonia are the EU member states with the highest achievement score and Bulgaria and Romania are the EU member states with the lowest

achievement score[1]. In addition to the international data results and the results for Slovenia and four other countries' results will be analysed in detail. The goal is to test whether the same predictions can be made in high and in low achieving countries. Since attribution styles are under the strong influence of culture (e.g. western cultures valuing ability more and eastern countries valuing effort more) (Nokelainen et al., 2007) we have chosen EU member states for the comparisons.

Method

Participants

In the analyses, a PISA international sample is used. PISA samples students aged between 15 and 16 years, disregarding the grade levels or type of institution in which they are enrolled and regardless of whether they are in full-time or part-time education. Therefore, the average age of students included in the survey is 15 years and 9 months (OECD, 2014). Most countries included in PISA used a two-stage stratified sampling design, which means that the sampling was conducted in two stages. The first stage consisted of sampling individual schools, where 15-year-old students might be enrolled. A minimum of 150 schools per country were sampled. The second stage of the sampling process consisted of sampling 15 year-old students at the selected schools. Approximately 35 15-year-old students were sampled per school with equal probability, however each country then chooses its own modified sampling design (OECD, 2014). With these sampling procedures the representativeness of the selected test population for each educational system was ensured.

PISA 2012 focused on mathematical literacy. There were approximately 510 000 students from 65 countries included in the survey. For the purposes of this article data from the Form B Questionnaire and Slovene, Bulgarian, Romanian, Estonian and Dutch data sets are used (N=309 104). Each student answered a cognitive test and a background questionnaire. PISA 2012 introduced a new rotation design for the student questionnaire, which is similar to the cognitive items design. Items are combined in packages, which are distributed over a number of different booklets. Each student is assigned one of these booklets and therefore receives a limited number of items, whereas all booklets together cover a larger pool of items from different scopes (OECD, 2013c).

1 Even though Cyprus was the EU member state with the second lowest mathematics achievement score, it was not included in the analysis since there were no available data for this country in the international database.

Table 1: Samples characteristics

	N	Gender (%)		Average achievement score of all students included in PISA 2012 (s. e.)
		Female (s. e.)	Male (s. e.)	
Slovenia	3 706	49 (0.9)	51 (0.9)	501 (1.2)
Netherlands	2 757	49 (0.8)	51 (0.8)	523 (3.5)
Estonia	3 127	51 (0.8)	49 (0.8)	521 (2.0)
Romania	3 314	51 (1.5)	49 (1.5)	440 (3.8)
Bulgaria	3 299	48 (1.9)	52 (1.9)	439 (4.0)

Note: All the data presented in this table are calculated using only the data for students who answered question ST43 (attribution for success) in Student Questionnaire.

In Slovenia 3 706 students were included (49% female and 51% male). The average mathematics achievement score for Slovenia is 501, whereas for Netherlands, which is the EU member state with the highest score, the average students' achievement score is 523 on the other hand for Bulgaria, the EU member state with the lowest score, the average students' achievement score is 439.

For the data analysis, two programmes were used as follows: SPSS for structures analysis and IDB Analyser for regression analysis.

Instruments

Background Questionnaires

In PISA 2012, students completed a 30-minute student questionnaire, which included questions on their background, attitudes toward mathematics and on their learning strategies (OECD, 2013c). These questions are of vital importance for the analyses of the results. In detail, the questionnaire includes:

- student and their family background (including their economic, social and cultural capital),
- aspects of the students' lives (their attitudes towards learning, their habits and life inside school, their family environment),
- aspects of learning and instruction in mathematics, including the students' interest, motivation and engagement (OECD, 2013c).

Cognitive Tests

PISA 2012 was composed of a paper-based assessment of the students' mathematics, science and reading literacy and a computer-based assessment of problem solving (NCES, 2014a). All PISA 2012 cognitive items were organized in clusters. The main competency tested in PISA 2012 was mathematical literacy. There were two possibilities to assess the mathematical literacy for countries. The first possibility was a set of 13 booklets, which included items distributed across a range of difficulty. Out of 7 mathematical clusters, 4 were included in these booklets according to a rotated test design. The booklets also included 3 reading clusters and 3 science clusters. Moreover, in each booklet there was at least one mathematical cluster. Regardless of a specific countries' choice, the performance of students in all participating countries is represented on a common mathematical literacy scale (OECD, 2013a).

Included Variables

Achievement scores for mathematics (Plausible values)

Each student had a different subset of items in their booklet; therefore scaling techniques were used to establish a common scale for all students. In PISA 2012, item response theory (IRT) was used to estimate average scores for measured competencies (mathematics included). This theory identifies patterns of response and uses statistical models to predict the probability of answering an item correctly as a function of the students' proficiency in answering other questions (NCES, 2014b).

Since each student completed only a subset of items, the students' scores are estimated as plausible values.[2] For each student five plausible values are estimated. These values represent the distribution of potential scores for all students in the population with similar characteristics and identical patterns of item response (NCES, 2014b).

Attribution for success in mathematics

The attribution for success in mathematics (internal and external) is measured with a set of questions (Question ST43). The question set measures the students' perceived control over their success in mathematics. This question examined the students' agreement with six statements about their mathematics lessons. Students had to evaluate whether they strongly agree (1)[3], agree (2), disagree (3) or strongly disagree (4) with the following statements: *If I put in enough effort I can succeed in mathematics; Whether or not I do well in mathematics is completely up to me; Family demands or other problems prevent me from putting a lot of time into my mathematics work; If I had different teachers, I would try harder in mathematics; If I wanted to, I could do well in mathematics; I do badly in mathematics whether or not I study for my exams* (OECD, 2013a).

2 More information on plausible values can be found in PISA Analysis Manual: http://browse.oecdbookshop.org/oecd/pdfs/free/9809031e.pdf.

3 Values in brackets are values of the variable entered in the database.

Attribution for failure in mathematics (perceived self-responsibility for failing mathematics)
Perceived self-responsibility for failing mathematics (FAILMAT) is an index constructed from students' responses to a set of questions from the background questionnaire. The questions examined the following situation: "*Suppose you are a student in the following situation: each week, your mathematics teacher gives you a short quiz. Recently you have done badly in these quizzes. Today you are trying to figure out why.*" Then followed six sentences that students had to evaluate whether they are very likely (1)[4], likely (2), slightly likely (3) or not at all likely (4) to have the following thoughts or feelings about this situation. The sentences describing the thought or feelings were as follows: *I'm not very good at solving mathematics problems; My teacher did not explain the concepts well this week; This week I made bad guesses on the quiz; Sometimes the course material is too hard; The teacher did not get students interested in the material; Sometimes I'm just unlucky* (OECD, 2013a).

Results

Structures Analyses

In order to define the underlying structure of the question set measuring the attribution for success in mathematics, the correlation matrix of the question set was subjected to factor analyses (method: principal axis factoring) on the international database. The preliminary test showed the data was suitable for this kind of analyses (KMO=0.670; Bartlett's Test of Sphericity (15) = 281867.271; $p<.001$).

Table 2: Total variance explained

Factor	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
Internal locus of control	2.065	34.411	34.411
External locus of control	1.490	24.841	59.252

The Kaiser-Guttmann criteria (Eigenvalues over 1) revealed two factors explaining 59.25 % of the question set total variance (Table 2). Based on the factor loading (Table 3) we named the two factors: *internal locus of control* and *external locus of control*. The first factor explains 34.411 % of variance and includes internal attributions for success in form of effort (internal, unstable, controllable) and own responsibility for success. The second factor explains 24.841 % of variance and includes external attributions for success in forms of external causes (external (e.g. teachers, family), stable, uncontrollable).

4 Values in brackets are values of the variable entered in the database.

Table 3: Factor loadings of attribution for success in mathematics question set

	Factor	
	Internal locus of control	External locus of control
If I put in enough effort, I can succeed in mathematics	.757	-.075
Whether or not I do well in mathematics is completely up to me	.634	-.038
Family demands or other problems prevent me from putting a lot of time into my mathematics work	.069	.546
If I had different teachers, I would try harder in mathematics	.006	.504
If I wanted to, I could do well in mathematics	.671	.012
I do badly in mathematics whether or not I study for my exams	-.253	.529

Regression Analyses

For the analysis of the relationship between attribution for success in mathematics and the students' mathematics achievement, regression analysis was used. The regression analyses are at the first stage of the analyses conducted on an international level, and further on also on a national (Slovene) level followed by international comparisons. We used two stages of multiple regression analyses. In the first stage, only attributions for success in mathematics indices were entered in the model. Furthermore, in the second stage, attributions for failure in mathematics index (perceived self-responsibility for failing mathematics) were added to the model on national and international level.

A multicollinearity assumption of predictors in the model was tested with correlation analyses. All indices (*internal locus of control, external locus of control and perceived self-responsibility for failing mathematics*) statistically significantly correlate with each other, either weakly or moderately ($0.02< r <0.34$). Additionally VIF[5] were significantly below 10 ($1.08<VIF<1.15$).

As it can be seen from the Table 4, international data shows attribution for success in mathematics (internal and external locus of control) as significant predictors of mathematics achievement in PISA 2012. The in-

5 In multiple regression, the variance inflation factor (VIF) is used as an indicator of multicollinearity. Computationally, it is defined as the reciprocal of tolerance: $1 / (1 - R^2)$.Various recommendations for acceptable levels of VIF have been published in the literature. Perhaps most commonly, a value of 10 has bee recommended as the maximum level of VIF (Field, 2000).

Table 4: Predictive power of attribution for success in mathematics (internal and external locus of control) for mathematics achievement in PISA 2012 – international and national level

International results	b (s. e.)	β (s. e.)	R^{2*} (s. e.)
constant	478.18* (0.39)		
Internal locus of control	-16.56* (0.29)	-0.16* (0.00)	
External locus of control	32.84* (0.38)	0.26* (0.00)	0.11 (0.00)
Slovenia			
constant	503.79* (1.6)		
Internal locus of control	-15.27* (2.11)	-0.14* (0.02)	
External locus of control	28.29* (2.73)	0.23* (0.02)	0.08 (0.01)
Netherlands			
Constant	529.78* (3.77)		
Internal locus of control	-14.99* (2.22)	-0.16* (0.02)	
External locus of control	36.26* (4.43)	0.26* (0.03)	0.11 (0.02)
Estonia			
constant	516.20* (2.06)		
Internal locus of control	-18.03* (2.18)	-0.18* (0.02)	
External locus of control	37.82* (2.37)	0.31* (0.02)	0.15 (0.01)
Romania			
constant	454.38* (3.86)		
Internal locus of control	-10.46* (2.39)	-0.11* (0.03)	
External locus of control	29.00* (3.13)	0.28* (0.03)	0.09 (0.02)
Bulgaria			
constant	444.41* (3.46)		
Internal locus of control	-12.71* (2.16)	-0.12* (0.02)	
External locus of control	40.96* (2.59)	0.36* (0.02)	0.14 (0.02)

Notes: The data are weighted with Final Student Weight. R^{2*} is adjusted R^2. All the data presented in this table are calculated using only the data for students who answered question ST43 (attribution for success) in Student Questionnaire. Statistically significant ($p > 0.05$) coefficients are marked with *.

ternational results of the data analysis show that if internal locus of control increases by one unit, the students' mathematics score increases by 16.6 score points (if external locus of control is constant). If external locus of control increases by one unit, then the students' mathematics score falls for 32.8 score points. Every unit increase in the external locus of control is therefore associated with 32.8 score points fall in the students' mathematics achievement (if the effect of internal locus of control is held constant). On an international level, the model accounts for 11 % of variance in the students' mathematics achievement score.

Likewise, the results of the data analysis for Slovenia show that if internal locus of control increases by one unit, the students' mathematics score increases by 15.3 score points. Therefore, every unit increase in the internal locus of control is associated with 15.3 score points increase in the students' mathematics achievement (if external locus of control is constant). If external locus of control increases by one unit, then the students' mathematics score falls for 28.3 score points. Every unit increase in the external locus of control is therefore associated with 28.3 score points fall in the students' mathematics achievement (if internal locus of control is constant). In Slovenia, the model accounts for 8 % of variance of the students' mathematics achievement score.

Further comparisons of the countries with the highest and lowest mathematics achievement scores in European Union showed that the regression model, which accounts for the highest percentage of variance (15 %), is the regression model for Estonia. The results of the data analysis for Estonia show that every unit increase in the internal locus of control is associated with 18 score points increase in the students' mathematics achievement (if external locus of control is constant). Every unit increase in the external locus of control is therefore associated with 36 score points fall in the students' mathematics achievement (if internal locus of control is constant). Moreover, the regression model for Romania accounts for the lowest percentage of variance (9%) in analysis. The results for Romania show that every unit increase in the internal locus of control is associated with 10 score points increase in the students' mathematics achievement (if the external locus of control is constant). Moreover, every unit increase in the external locus of control is therefore associated with 29 score points fall in the students' mathematics achievement (if the internal locus of control is constant).

Table 5 shows that the inclusion of an additional index of attribution for failing mathematics does not add to percentage of explained variance to the original regression model which includes only an attribution for success in mathematics indices. The inclusion of an additional index of

Table 5: Regression model with attribution for (perceived self-responsibility for failing mathematics - FAILMAT) index included

	b (s. e.)	β (s. e.)	R^{2*} (s. e.)
International results			
constant	477.65* (0.40)		
Internal locus of control	-16.01* (0.30)	-0.15* (0.00)	
External locus of control	30.84* (0.39)	0.25* (0.00)	
FAILMAT	-3.52* (0.29)	-0.04* (0.00)	0.11 (0.00)
Slovenia			
constant	504.75* (1.69)		
Internal locus of control	-15.38* (2.12)	-0.14* (0.02)	
External locus of control	26.56* (3.11)	0.21* (0.02)	
FAILMAT	-3.75 (2.12)	-0.04 (0.02)	0.08 (0.01)
Netherlands			
constant	529.82* (3.77)		
Internal locus of control	-15.13* (2.19)	-0.17* (0.02)	
External locus of control	36.94* (4.58)	0.26* (0.03)	
FAILMAT	1.28 (0.01)	0.01 (0.03)	0.11 (0.01)
Estonia			
constant	516.52* (2.33)		
Internal locus of control	-17.94* (2.02)	-0.18* (0.02)	
External locus of control	37.44* (2.57)	0.31* (0.02)	
FAILMAT	-1.04 (-0.01)	-0.01 (0.02)	0.15 (0.01)
Romania			
constant	455.15* (3.86)		
Internal locus of control	-10.52* (2.37)	-0.11* (0.02)	
External locus of control	27.97* (3.20)	0.27* (0.03)	
FAILMAT	-2.66 (1.96)	-0.03 (0.02)	0.09 (0.02)

	b (s. e.)	β (s. e.)	R^{2*} (s. e.)
Bulgaria			
constant	444.48* (3.26)		
Internal locus of control	-12.72* (2.15)	-0.12* (0.02)	
External locus of control	41.45* (2.79)	0.37* (0.02)	
FAILMAT	0.17 (1.99)	0.00 (0.02)	0.15 (0.02)

Notes: The data are weighted with Final Student Weight. FAILMAT is an abbreviation for the index "perceived self-responsibility for failing mathematics". R^{2*} is adjusted R^2. All the data presented in this table are calculated using only the data for students who answered question ST43 (attribution for success in mathematics) in Student Questionnaire. Statistically significant ($p > 0.05$) coefficients are marked with *.

attribution for failing mathematics accounts for an additional 1 % only for Bulgaria. For the international data and the rest of the countries (Slovenia, Netherlands, Estonia and Romania), the percentage of variance explained stays the same after the inclusion of additional predictor. Therefore, it can be concluded that the inclusion of the new predictor has not explained a large amount of the variation in students' mathematics achievement scores. The attribution for failure (perceived self-responsibility for failing mathematics) is a weaker predictor for the students' mathematics achievement score than the predictors of the attribution for success.[6] Moreover, the predictor attribution for failure (perceived self-responsibility for failing mathematics) is statistically significant in predicting students' mathematics achievement scores only on the international level.

Discussion

Internal locus of control as measured in PISA study is a significant predictor of higher mathematics achievement on international level and based on the samples included also regardless of average levels of mathematics achievement (Slovenia, Netherlands, Estonia and Romania). Likewise external locus of control significantly predicts lower mathematics achievement on an international level and in selected countries. The results showed predictive stability – in other words the predictors were significant in all analysed countries. In Slovenia, the students' attribution style explains 8 % of the total mathematics achievement score indicating the relevance of the analysed field.

6 The analysis of the data gave the same results when changing the order of predictors and including the predictor of "FAILMAT" as the first predictor in the regression analysis.

Based on our results, internal locus of control should be supported in educational setting. Inclusion of an additional index of the attribution for failure (perceived control responsibility about failing math) does not increase prediction value to a larger extent. This indicates that the attribution for success is something we should pay attention to in the educational setting. For instance, teachers could focus on communicating praises for success in a matter that promotes effort (internal, instable controllable attributions).

Hence, the main question for our discussion is how is attributional information developed in the course of one's development. Besides one's own experiences and social norm information, which is the strongest source, also feedback from teachers is relevant to motivation in school, especially because teachers are often unaware of the attributional information that they indirectly convey. For instance, laboratory – experimental studies showed that three types of behaviour that a teacher frequently poses could be problematic in communicating low ability (internal, stable, uncontrollable attribution) of student. These are (Graham and Williams, 2009): sympathy following failure, the offering of praise following success especially at easy tasks and unsolicited offers of help. In classroom teachers reward the effortful (internal, unstable, controllable attribution) student and punish the non effortful and unmotivated students. When a teacher attributes student's failure to lack of effort the student is perceived to be responsible, anger is elicited, and punishment or reprimand is handed out. In contrast, when failure is attributed to low aptitude and the student is perceived as not responsible sympathy is aroused, and help may be offered (Graham and Williams, 2009; Reyna and Weiner, 2001; Rudolph et al., 2004). That is, one tends to be sorry for the student who lacks ability, or is sick or breaks down on the way to school (Reyna and Weiner, 2001). In contrast to failure, being attributed to controllable causes such as lack of effort tends to evoke anger with withdrawal of help. This means that if a student experiences sympathy when faced with failure they also interprets this sympathy as attributional information stating that the event (e.g. failure) is uncontrollable. Unsolicited help has the same effect. This effect is evident even when students of different ages observe teacher behaviour toward other students. For instance, when observed on tape: the student that was given unsolicited help from their teacher was perceived as less able in comparison to their classmate that did not receive help from the teacher (Graham and Baker, 1990). Studies (among college students and children) showed that students who were praised for success at a relatively easy task were inferred to be of a lower ability in comparison to their classmates who were given neutral feedback (Graham and Williams, 2009).

We are not suggesting that these types of teacher's feedback always work but some critical attention has to be put also to this aspect especially in regards of unsolicited help. Stepping back and not providing help if not directly asked is supported based on the theoretical assumptions and also our data indicating that internal locus of control should be supported. Not providing help or waiting a little bit longer than usual not only supports controllable internal attribution styles but also supports autonomy as one of the basic foundations of inner motivation (Ryan and Deci, 2009).

Besides informing teachers in the form of teacher training on specific competences and on effort praise depending on the task difficulty, also student trainings have proven to be successful. In these types of intervention, teachers or other trained professionals guide students towards attributing failure to lack of effort. Dweck (1975 in Graham and Williams, 2009) has shown that students that have had helpless attributions (e.g. stable low ability) and have gone through attribution retraining have shown more persistence and more effort in future tasks compared to their control group (students of similar attribution style but without attribution retraining). Attribution based intervention have for instance in a group of college students resulted in 18 % higher rate in passing the final exam (Van Overwalle and De Metsenare, 1990). Nevertheless, all the studies have not yielded such promising results (Stroud and Reynolds, 2009) and additional research in the field is needed.

It is also recommended that training should be subject-area specific – as our empirical study was targeting only mathematics achievement. Vispoel and Austin (1995) showed a systematic trend for external attributions to generalize across subject areas and for internal attributions to remain subject-area specific. In school, elementary students' current and future attributions perceptions have been found to vary daily across assignments (Shell and Husman, 2008). It is of high importance to add that attribution beliefs are only one piece of puzzle in achievement motivation theoretically and empirically interrelated with other motivational construct such as goal orientation and affect. Shell and Husman (2008) pointed out that we cannot simply expect a rise in achievement solely by influencing one component of motivation.

Taking Ajzens' theory (OECD, 2013b) of planned behaviour as a framework (this framework was used in the development of PISA 2015 questionnaires), we can assume that by influencing internal control belief, we can foster one's behaviour e.g. mathematics related effort, mathematic related student behaviour and indirectly if possible students mathematics outcome. Even the theory of planned behaviour states that volitional behaviour is determined by specific attitudes and subjective norms together with perceived control (OECD, 2013b).

To sum up, our study firstly offers two newly developed indices based on the PISA 2012 question set measuring attribution for success in mathematics (*internal locus of control* and *external locus of control*) over one's success. These two indices could be used in further analyses in the field and also in the data sets not included in our analyses. The study offered empirical international support for the significant relationship between internal locus of control and higher academic achievement (in our case PISA mathematics achievement) and likewise external locus of control and low achievement.

Despite the contributions offered by this study, its limitations should also be noted. First of all, the measurement of the attribution for success is limited to six items therefore the findings should be considered as a form of screening and be used as a baseline for further more in depth measurement of attribution style. The study included only a selection of countries therefore the conclusions could be generalized to other European countries to a certain extent but keeping in mind that the results are based on five selected countries. Based on our results, we can recognize the possibility of larger predictive value of attribution style in low achieving countries when compared to high achieving countries. However, in order to make these kind of conclusions we would have to include the whole PISA sample and conduct more in depth analyses. In the regression model, only newly developed indices were used (together with the attribution for failure in mathematics) mainly because we wanted to isolate the predictive power of the attributions for success in mathematics for mathematics achievement but at the same time this means that larger regression models could explain achievement in larger extent.

To conclude, success in school depends on numerous factors, many of which are not fully controllable or easily identified. Therefore, it is of vital importance that we identify factors that we can influence and, in such a way, help the students to reach better educational achievements on all levels and in all fields.

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