Metakognicija i inteligencija kao prediktori školskog uspjeha

Vrdoljak, Gabrijela; Velki, Tena

Source / Izvornik: **Croatian Journal of Education-Hrvatski Casopis za Odgoj i obrazovanje, 2012, 14, 799 - 815**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:141:545839

Croatian Journal of Education
Vol: 14 (4/2012), pages: 799-815
Original scientific paper
Paper submitted: 20th May 2011
Paper accepted: 2nd November 2011

Metacognition and Intelligence as Predictors of Academic Success

Gabrijela Vrdoljak[1] and Tena Velki[2]
[1]*Faculty of Humanities and Social Sciences, University of Josip Juraj Strossmayer in Osijek,*
[2] *Faculty of Teacher Education, University of Josip Juraj Strossmayer in Osijek*

Abstract

Schraw and Mohsman (1995; according to Schraw, Crippen and Hartley, 2006) define metacognition as the knowledge and regulation of cognitive processes. Unlike cognition, which only involves the execution of tasks, metacognition encompasses the understanding of how a task is accomplished. Metacognitive processes are important because they bring about conceptual changes in learning, thus enabling longer retention and different application of the material. In various studies, cognitive abilities have proven to be a significant predictor of academic success, the correlation coefficients between the general intelligence and school grades in primary school amounting to an average of about 0.5 (Neisser et al., 1996). Studies of metacognition and intelligence have shown that metacognition and cognitive abilities are two different constructs, and that a high degree of metacognitive self-regulation can compensate for a lower problem solving ability (Howard, McGee, Shia and Hong, 2001).

The aim of our study was to examine the possibility to predict academic success on the basis of the level of cognitive and metacognitive development (with seventh and eighth grade primary school pupils). The following instruments were used in the study: the Metacognitive questionnaire (Vizek-Vidović, 1995; according to Zoričić, 1995), the Cognitive-non-verbal test (Sučević, Momirović, Fruk and Auguštin, 2004), and the Mill Hill vocabulary test (Lewis et al., 1977; according to Križan and Matešić, Jr, 2001). The results have shown that metacognition, apart from intelligence, is a significant predictor of academic success. The obtained results have direct implications for the teaching practice because they show that pupils who

score higher on the Metacognitive questionnaire have higher grades in school, and we can teach metacognition to our pupils.

Key words: *academic success; intelligence; metacognition; pupils*

Introduction

Psychologists have always taken interest in predicting academic success due to the fact that academic success directly influences one's options of choosing a school and a job, and has an impact on other aspects of a person's life as well. According to Babarović, Burušić & Šakić (2009) students' academic achievement can be predicted on the basis of the following traits: the characteristics of the student (e.g. age, gender, cognitive abilities; which account for 40% of the variance), family and social environment the student comes from (account for 10% of the variance), the characteristics of the teachers (account for 5% of the variance), and the characteristics of the school (account for about 2-3% of the variance).

Babarović, Burušić & Šakić state that about 55% to 60% of the individual differences in students' academic success can be explained on the basis of all of the above mentioned variables. As we can see, students' characteristics are by far the best predictor of their academic success; hence researchers take great interest in them. The survey given in this article presents an attempt to predict academic success on the basis of two characteristics of the students, namely intelligence and metacognition.

In various surveys cognitive abilities have proven to be an important predictor of academic success, with the correlation coefficients between the general intelligence and school grades in primary school being about 0.5 on average (Neisser et al., 1996). However, the extent of that correlation decreases with age, that is, with the level of education. Chamorro-Premuzic & Furnham (2005) give the following correlations between intelligence and school success of different age groups: between 6 and 12 years of age it is $r = 0.6$; between 13 and 18 years of age it is $r = 0.4$; and between 19 and 22 years of age it is $r = 0.3$.

Schraw & Moshman (1995, according to Schraw, Crippen & Hartley, 2006) define metacognition as the knowledge and regulation of cognitive processes. As opposed to cognition, which only involves the completion of the task, metacognition involves the understanding of the way a task is completed. Metacognitive processes are important because they lead to conceptual changes in learning enabling longer retention and different application of the materials (Georghiades, 2004). Kipins & Hofstein (2008) state that it is important to encourage metacognitive skills due to the following: 1. Metacognitive processes promote learning with understanding. Learning with understanding implies the possibility that the acquired knowledge is applied in the new context; 2. With the constant change of technology current knowledge becomes insufficient and one needs to learn new skills that will be essential in the future; 3. Metacognitive skills provide individual learning which requires the awareness of the individual knowledge and the understanding of how to expand that knowledge.

The research carried out by Howard, McGee, Shia & Hong (2000; 2001) has shown that metacognition and abilities are two different constructs, and that a high degree of metacognitive regulation can compensate for lower abilities in succeeding to solve problem tasks.

The aim of this study was to investigate the possibility to predict academic success on the basis of the levels of cognitive and metacognitive development.

Method

Participants

A total of 172 pupils (83 boys and 82 girls) attending 7th and 8th grades of primary schools participated in the study. Eleven pupils, for whom we had not been able to collect all the information required, were excluded from the analysis. This mostly occurred in the classes in which the gathering of the data was conducted during the first or the last period. Some pupils were late for the first period (they had to go to the doctor's, they overslept, etc.) whereas some pupils asked their teachers to be excused from the last period for various reasons.

Instruments

For the purpose of this study a special form was designed with which all the data were collected: age, gender, the class a pupil attends, the academic success from the previous grade and term, the final grade in mathematics and Croatian at the end of the previous school year and at the end of the previous term.

Cognitive-non-verbal test – CNT (Sučević, Momirović, Fruk & Auguštin, 2004)

The CNT is a non-verbal test used for examining logical **reasoning (g- factor** of intelligence). It consists of 40 tasks with drawings of geometrical shapes. The examinee's task is to decide for each task which of the four drawings is significantly different from the other three. The test is suitable for examinees aged 11 and older, and it can be applied in groups or individually. The test takes 15 minutes to complete. The coefficient of reliability of internal consistency is $r_{tt} = 0.928$.

Mill Hill vocabulary test – series B for children (Lewis et al., 1977; according to Križan & Matešić, Jr 2001)

The aim of the Mill Hill vocabulary scale is to record examinee's ability of verbal communication. Series B for children consists of 44 multiple choice tasks and is suitable for children aged between 11 and 14. The examinee is to choose a word, out of the 6 words provided, which corresponds best to the meaning of the given word. The whole Mill-Hill vocabulary scale consists of Series A and series B. Series A consists of 44 open-ended tasks, but it was not used in this study. According to the authors, when only a brute estimation of an individual's verbal achievement is needed, a version of the multiple choice test can be applied (with a version of open-ended tasks we get more qualitative information). The coefficient of the reliability of internal consistency for series B is $r_{tt} = 0.90$.

Metacognitive questionnaire (Vizek-Vidović, 1995; according to Zoričić, 1995),

The Metacognitive questionnaire is a self-perception questionnaire which examines self-evaluation of the material learned and the request for feedback. The Metacognitive questionnaire consists of 14 statements, for which the pupil has to evaluate to which extent each statement refers to him/her on a scale from 1 to 5 (1 - never, 5 - always). The coefficient of reliability of internal consistency is $r_{tt} = 0.84$.

Procedure

Every pupil was informed about the general aims and purpose of the study, and it was made clear to them that their participation in the study was voluntary and anonymous. Also, they were assured that the information would be used for scientific purposes only. Prior to this, the teachers had collected written consents from the parents agreeing that their children participate in the study.

The information was gathered in groups during 45-minute-long periods. After the questionnaires and the instructions had been distributed, the experimentator read the instructions out loud, instructing the pupils on how to solve the tests of intelligence. Time allotted for solving the tests of intelligence was limited, and the experimentator signalled the start and the end of solving the tests of intelligence. First, the pupils solved the Cognitive non-verbal test, and then the Mill-Hill vocabulary test. The time allowed for filling in the Metacognitive questionnaire and the general information form was not limited. When the pupils were finished filling in the questionnaires, they could ask questions and they were given an e-mail contact in case they should have any other additional questions.

Results and Discussion

The preconditions for conducting parametric statistics and regression analysis were met. Predictor and criterion variables are quantitative and at the interval level, variances of the predictor are not zero, there is no perfect multicolinearity, predictors are not in too high correlations, predictors are not connected with "external variables", there is no third variable, in terms of a moderator, which could influence cohesion with the predictors, homogeneity of the variance has also been satisfied, Watson-Durbin test proved the independence of error, residuals are in zero correlations, error distribution does not differ significantly from the normal distribution, variables cohesion is linear and they were independently measured. Therefore, the data was analyzed by means of the hierarchical regression analysis.

Table 1. *Basic descriptive statistics for all tested variables (N=170)*

Examined variables	M	min	max	SD
Age	13.11	12	14	0.67
Academic success from the previous grade	4.27	1	5	0.73
Academic success from the previous term	4.31	1	5	0.73
Final grade in mathematics at the end of the school year	3.22	1	5	1.12

Final grade in mathematics at the end of the term	3.27	1	5	1.17
Final grade in Croatian at the end of the school year	3.70	2	5	1.09
Final grade in Croatian at the end of the term	3.80	1	5	1.06
KNT	21.14	3	39	7.65
Mill-Hill vocabulary test	24.36	5	32	5.42
Metacognitive questionnaire	3.69	1	5	0.66

In data analysis, the descriptive statistics for the variables which were included in the study were first calculated. Then, the intercorrelations of the variables examined (Table 2) were calculated.

For the variable *success* the average values of the sum of the pupils' academic success from the previous year and the previous term were used. The variables *success in mathematics* and *success in Croatian* were obtained in the same manner. The achievement in mathematics and Croatian (with the general academic success at the end of the school year/term) was chosen because in primary school pupils mostly have very good and excellent grades. This decreases the variability of the general academic success. Croatian and mathematics are usually considered to be the basic subjects in the primary school; therefore the criteria are more severe in comparison to some other subjects. So, it is expected that in these variables, the variability would be higher in relation to the general academic success. Also, these subjects (Croatian and mathematics) represent an approximation of the fluid and crystallized intelligence (Cattell, 1971; Horn & Cattell, 1966; Horn, 1982; according to Matešić, Jr & Zarevski, 2008). The variables *general academic success*, *success in Croatian* and *mathematics* are operationalized as average grade values at the end of the term and at the end of the school year, because it was expected that the teachers would lower their marking criteria at the end of the school year, when they give final grades (if a pupil's grade is between a 4 and a 5, it is better to give 5 than 4), and by that the variability at the end of the school year is decreased. In their study of the correlation between intelligence and personality traits and academic achievement, Matešić, Jr & Zarevski (2008) use term grades because of their great range in relation to the end of the school year.

Table 2. *Intercorrelation of tested variables*

Examined variables	1	2	3	4	5
1. CNT					
2. Vocabulary test	.385**				
3. Metacognitive questionnaire	.061	.206**			
4.General academic success	.445**	.468**	.287**		
5. Success in mathematics	.449**	.314**	.234**	.914**	
6. Success in Croatian	.400**	.537**	.300**	.931**	.738**

*** coefficients of correlation are significant at the level risk 0.01*

Further analysis was based on calculating the correlations between the variables (Table 2). According to the results, all correlations are significant, except for the correlation between the CNT and the Metacognitive questionnaire. The correlations

between the CNT and academic success (general academic success, Croatian and mathematics) range from r = 0.40 to r = 0.45, which is in accordance with Chamorro-Premuzic and Furnham (2005) who state that the correlation between intelligence and academic success from age 13 to age 18 is about r = 0.4. The correlation between the Vocabulary test and academic success is also about r = 0.4, even tough we can see that the Vocabulary test correlates more with the success in Croatian r = 0.54 than with the success in mathematics r = 0.30, while for the academic success it is similar as in the CNT r = 0.47. The correlation between the CNT and the Metacognition questionnaire is not significant, which is expected as we have assumed that intelligence and metacognition are two different constructs, which is in accordance with Howard, McGee, Shia and Hong (2000; 2001). Also, the lack of a significant correlation can be the result of the CNT and Metacognition questionnaires being two completely different materials. The CNT is a non-verbal test of a maximal effect, and the Metacognition questionnaire is a verbal material which demands participants' self-evaluation of their behavior in typical learning situations. That was the main reason for including the Vocabulary test into this study. The correlation between the Vocabulary test and metacognition is low, but significant (r = 0.206; p<0.01). This was expected because there is verbal material used in both cases, and some particles in the Metacognition questionnaire were expected to be connected to the verbal communication ability (example of particles: *If something is not clear to me when I read, I repeatedly go back to the same sentence, paragraph,* or *I check if I have understood the terms (words) well).* However, since this is a low correlation, we can conclude that in this case the hypothesis stating that metacognition and intelligence are two different constructs has been confirmed as well. Taking into consideration that both the Vocabulary test and metacognition are in a significant correlation with the general academic success (r = 0.468; p=<0.01 and r = 0.287; p<0.01), partial correlation for metacognition (with the control of the Vocabulary test) was calculated in order to ascertain whether the additional part of the academic success variance could be explained by metacognition (with the Vocabulary test). It was proven that correlation decreased, but it was still significant (r = 0.22; p<0.01), which goes in favour of the hypothesis that metacognition is also important in explaining academic success.

As it has been mentioned before, the aim of this study was to determine to which extent it is possible to predict academic success on the basis of the results of the intelligence tests and the metacognition questionnaire carried out with the 7th and 8th grade primary school pupils. Therefore, in this study the predictors were intelligence and metacognition, and as a criterion, beside the general academic success, the success in Croatian and mathematics was considered. In accordance with that, three hierarchical regression analyses were conducted in order to determine to which extent intelligence and metacognition predict academic success in the higher grades of primary school. The hierarchical regression analysis differed according to the criterion that was used. In the first step, in all three cases, the Vocabulary test and the CNT were

included, and in the second step, metacognition was added (in order to ascertain to which extent metacognition additionally contributes to explaining the predictors). For general academic success, the results have shown that all predictors together predict 34% of the variance, 30% is predicted by intelligence (CNT and Vocabulary test), while the additional 4% of the variance is explained by metacognition (Table 4). The best predictor of the general academic success has proven to be the Cognitive non-verbal test.

Table 3. *Regression analysis of academic success on intelligence (CNT and Vocabulary test) and metacognition*

Predictor	β	t	p
CNT	.311	4.464	.000
Vocabulary test	.348	4.995	.000
Regression model	R= 0.549; R^2 = 0.301 R^2_{kor} = 0.293 $F_{(2.169)}$ =36.425; p < 0.001		
CNT	.315	4.649	.000
Vocabulary test	.304	4.393	.000
Metacognitive questionnaire	.205	3.206	.002
Regression model	R= 0.584; R^2 = 0.342 (final version) R^2_{kor} = 0.33 $F_{(3.168)}$ =29.044; p < 0.001		

In the cases in which the achievement in Croatian was taken as a criterion, it explained 37% of the variance, 33% of the variance was explained by intelligence and 4% by metacognition (Table 4). In this case, the best predictor has proven to be the Vocabulary test, followed by the CNT, and the Metacognitive questionnaire.

Table 4. *Regression analysis of academic success in Croatian on intelligence and metacognition*

Predictor	β	T	p
CNT	.226	3.324	.001
Vocabulary test	.450	6.612	.000
Regression model	R= 0.577; R^2 = 0.332 R^2_{kor} = 0.325 $F_{(2.169)}$ =42.088; p < 0.001		
CNT	.231	3.479	.001
Vocabulary test	.407	6.020	.000
Metacognitive questionnaire	.202	3.224	.002
Regression model	R= 0.609; R^2 = 0.371 (final solution) R^2_{kor} = 0.36 $F_{(3.168)}$ =33.083; p < 0.001		

When achievement in mathematics was taken as a criterion, it explained 25.7% of the variance, 22.5% of the variance was explained by intelligence and 3.2% by metacognition (Table 5). Mathematics is best predicted by CNT, followed by the Metacognitive questionnaire, and the Vocabulary test.

Table 5. *Regression analysis of academic success in mathematics on intelligence (CNT and Vocabulary test) and metacognition*

Predictor	β	T	p
CNT	.385	5.244	.000
Vocabulary test	.166	2.255	.025
Regression model	R= 0.474; R^2 = 0.225 R^2_{kor} = 0.215 $F_{(2.169)}$ =24.478; p < 0.001		
CNT	.389	5.395	.000
Vocabulary test	.126	1.715	.088
Metacognitive questionnaire	.184	2.705	.008
Regression model	R= 0.507; R^2 = 0.257 (final solution) R^2_{kor} = 0.244 $F_{(3.168)}$ =19.369; p < 0.001		

We can say that, generally, cognitive abilities are better predictors of academic success than is metacognition, which was expected due to the fact that cognitive abilities serve as the best individual predictor of academic success. It is interesting to observe that the CNT has proven to be the best predictor of general academic success, followed by the Vocabulary test, and finally by metacognition. The achievement in Croatian is best predicted by the Vocabulary test, followed by the CNT, and the Metacognitive questionnaire, while the achievement in mathematics is best predicted by the CNT, followed by the Metacognitive questionnaire, and the Vocabulary test. We can say that the results are in accordance with our expectations, since it can be assumed that the achievement in Croatian will be best predicted by pupils' verbal abilities, while for the mathematical skills of evaluation and monitoring, metacognition may be more important than the verbal abilities. Veenman (2005) also points out the importance of the verbal abilities in solving mathematical tasks. Veenman & Stel (2008) study the relation between intelligence and metacognition, and successfulness in mathematics and history tasks with twelve-year-olds. The study showed that intelligence alone accounts for 5.2% of the variance of success in the history task, and 15.2% the success in the mathematics task. Metacognition alone accounts for 28% of the variance of success in the history task, and 10.9% the success in the mathematics task. In this case, metacognition was measured by verbal protocols that were gathered by *talking out loud,* which many authors find to be the best measurement of metacognition (e.g. Sandi-Ureña, 2008). Desoete (2007) used more measures of metacognition in anticipating success on a mathematics test with pupils attending lower grades of primary school. The best measure proved to be the teacher's estimation of pupils' metacognitive skills and it proved to account for 22% of the variance of success on the mathematics test. We can assume that the low percentage of the explanation of variance on the mathematics test by means of the Metacognitive questionnaire in our study was partially the result of the problematic measurement of this concept, and the self-evaluation measure in particular. The problem lies in relying on the

participant's abilities to remember and reconstruct his/her learning experiences and task solving. The other problem (common in self- evaluation questionnaires) is the referent point problem which the participant considers when evaluating and giving socially-desirable responses**.** In that case, the participant's answer can be influenced by his/her expectations and perception of what it is that others expect of him/her (Thorndike, 2005, according to Sandi-Ureña, 2008).

Conclusion

We can conclude that cognitive abilities have proved to be good predictors of academic success, which corresponds to the results of the previous studies (Nieser et al., 1996). Metacognition, which is a recent concept, has also proved to be a significant predictor for all three criteria (the general academic success, Croatian and mathematics), even though it is clear that metacognition could not account for a great part of the academic success variance (3-4%). We can assume that better measures (or using more measures) of metacognition would show greater contribution in explaining academic success. This has great implications on the psychology of education due to the fact that we cannot influence pupils' cognitive abilities, while cognitive skills can be developed and trained and can so contribute to improving pupils' success in various academic tasks.

References

Babarović, T., Burušić, J. i Šakić, M. (2009). Uspješnost predviđanja obrazovnih dostignuća učenika osnovnih škola republike hrvatske. *Društvena istraživanja, 4-5*, 673-695.

Chamorro-Premuzic, T., & Furnham, A. (2005). *Personality and intellectual competence.* New Jersey: Lawrence Erlbaum Associates.

Desoete, A. (2007). Evaluating and improving mathematics teaching-learning process through metacognition. *Electronic Journal of Research in Educational Psychology, 13*(5), 705-730.

Georghiades, P. (2004). From general to situated: three decades of metacognition. *International Journal of Science Education, 27*, 365-383.

Howard, B.C., McGee, S., Shia, R., & Hong, N.S. (2001). *The influence of metacognitive self-regulation and ability levels on problem solving*. Seattle: Educational Research Association.

Howard, B.C., McGee, S., Shia, R., & Hong, N.S. (2000). *The influence of metacognitive self-regulation on problem solving in computer-based inquiry*. New Orleans: Educational Research Association.

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

Križan, L. i Matešić, ml., K. (2001). *Preliminarni priručnik za Mill Hill ljestvice rječnika*. Jastrebarsko: Naklada Slap.

Matešić, ml., K. i Zarevski, P. (2008). Povezanost opće inteligencije i dimenzija ličnosti sa školskim postignućem. *Metodika, 9,* 260-270.

Momirović, A. i Sučević, Đ. (2004). *Priručnik za kognitivno neverbalni test*. Jastrebarsko: Naklada Slap

Neisser, U., Boodoo, G., Bouchard, T.J., Boykin, A.W., Brody, N., Ceci, S.J., Halpern, D.F., Loehlin, J.C., Perloff, R., Sternberg, R.J., & Urbina, S. (1996). Intelligence: Knowns and unknowns. *American Psychologist*, *51*, 77-101.

Sandí-Ureña, G.S. (2008). *Design and validation of a multimethod assessment of metacognition and study of the effectiveness of metacognitive interventions*. Doctoral dissertation. Clemson, SC: Clemson University.

Schraw, G., Crippen, K.J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education*, *36*(1-2), 111-139.

Stel, M., & Veenman, M.V.J. (2008). Relation between intellectual ability and metacognitive skillfulness as predictors of learning performance of young students performing tasks in different domains. *Learning and Individual Differences, 18*, 128-134.

Sučević, Đ., Momirović, A., Fruk G. i Auguštin, B. (2004). *Kognitivno neverbalni test – KNT.* Jastrebarsko: Naklada Slap.

Veenman, M.V.J. (2005). The assessment of metacognitive skills: What can be learned from multi-method designs? In C. Artelt & B. Monschner (Eds.), *Lernstrategien und metakognition: Implikationen fuer forschung und praxis* (pp. 77-100). Berlin: Waxmann.

Zoričić, Ž. (1995). *Provjera nekih metrijskih karakteristika Upitnika za ispitivanje kognitivnih strategija učenja.* Diplomski rad, Filozofski fakultet, Zagreb.

Gabrijela Vrdoljak
Faculty of Humanities and Social Sciences,
University of Josip Juraj Strossmayer in Osijek
Lorenza Jägera 9, 31 000 Osijek, Croatia
gabrijela_p_hr@yahoo.com

Tena Velki
Faculty of Teacher Education,
University of Josip Juraj Strossmayer in Osijek
Ulica cara Hadrijana b.b.. 31 000 Osijek, Croatia
tena.velki@gmail.com

Metakognicija i inteligencija kao prediktori školskog uspjeha

Sažetak

Schraw i Moshman (1995; prema Schraw, Crippen i Hartley, 2006) definiraju metakogniciju kao znanje i regulaciju kognitivnih procesa. Za razliku od kognicije, koja obuhvaća samo izvršavanje zadatka, metakognicija obuhvaća razumijevanje na koji način je zadatak izvršen. Metakognitivni procesi su važni jer dovode do konceptualnih promjena u učenju, što omogućuje duže zadržavanje materijala i primjenu na nov način (Georghiades, 2000). Kognitivne sposobnosti su se u različitim istraživanjima pokazale kao važan prediktor školskog uspjeha, koeficijenti korelacije između opće inteligencije i školskih ocjena u osnovnoj školi iznose u prosjeku oko 0,5 (Neisser i sur., 1996). Istraživanja metakognicije i inteligencije su pokazala da su metakognicija i kognitivne sposobnosti dva različita konstrukta te da (Howard, McGee, Shia i Hong, 2001) visok stupanj metakognitivne samoregulacije može kompenzirati niže sposobnosti u uspješnosti rješavanja problemskih zadataka.

Cilj našeg istraživanja bio je provjeriti mogućnost predviđanja školskog uspjeha na temelju stupnja kognitivnog i metakognitivnog razvoja kod učenika sedmih i osmih razreda osnovne škole. U istraživanju su korišteni slijedeći instrumenti: Upitnik metakognicije (Vizek-Vidović, 1995; prema Zoričić, 1995), Kognitivno-neverbalni test (Sučević, Momirović, Fruk i Auguštin, 2004) i ljestvica rječnika Mill Hill (Lewis i sur., 1977; prema Križan i Matešić, ml., 2001). Rezultati su pokazali da je metakognicija, izuzevši inteligenciju, značajan prediktor školskog uspjeha. Dobiveni rezultati imaju i direktne implikacije na praksu jer su veći rezultati na Upitniku metakognicije povezani s većim ocjenama iz hrvatskog i matematike te općim uspjehom, a metakognicija je nešto čemu možemo poučavati učenike.

Ključne riječi: *akademski uspjeh; inteligencija; metakognicija; učenici*

Uvod

Predviđanje školskog uspjeha oduvijek je bilo zanimljivo psiholozima s obzirom na to da školski uspjeh izravno utječe na mogućnosti odabira škole i posla, a time i na mnoge druge aspekte života pojedinca. Prema Babarović, Burušić i Šakić (2009)

obrazovna dostignuća učenika mogu se predviđati na temelju slijedećih obilježja: obilježja učenika (npr. dob, spol, kognitivne sposobnosti; kojima se može objasniti oko 40% varijance), obiteljska i socijalna okolina iz koje učenik dolazi (objašnjavaju oko 10% varijance), obilježja učitelja (mogu objasniti oko 5% varijance), te obilježja škole (objašnjavaju oko 2-3% varijance).

Isti autori navode da se na temelju svih navedenih varijabli može objasniti oko 55 do 60% individualnih razlika u dostignuću učenika. Kao što možemo vidjeti, obilježja učenika su daleko najbolji prediktor školskog uspjeha pa vjerojatno zbog toga bude najveći interes istraživača. Istraživanje koje ćemo prikazati u ovom članku je pokušaj predviđanja školskog uspjeha na temelju dva obilježja učenika, a to su: inteligencija i metakognicija.

Kognitivne sposobnosti su se u različitim istraživanjima pokazale kao važan prediktor školskog uspjeha, koeficijenti korelacije između opće inteligencije i školskih ocjena u osnovnoj školi iznose u prosjeku oko 0,5 (Neisser i sur. 1996). Međutim, veličina te veze se smanjuje s dobi, odnosno stupnjem školovanja. Chamorro-Premuzic i Furnham (2005) navode da su korelacije između inteligencije i školskog uspjeha različitih dobnih skupina sljedeće: u dobi između 6 i 12 godina iznosi r = 0,6; u dobi između 13 i 18 godina iznosi r = 0,4; u dobi između 19 i 22 godine r = 0,3.

Schraw i Moshman (1995, prema Schraw, Crippen i Hartley, 2006) definiraju metakogniciju kao znanje i regulaciju kognitivnih procesa. Za razliku od kognicije koja obuhvaća samo izvršavanje zadatka, metakognicija obuhvaća razumijevanje na koji način je zadatak izvršen. Metakognitivni procesi su važni jer dovode do konceptualnih promjena u učenju što omogućuje duže zadržavanje materijala i primjenu na nov način (Georghiades, 2004). Kipins i Hofstein (2008) navode da važnost poticanja metakognitivnih vještina leži u sljedećim spoznajama: 1. Metakognitivni procesi promiču učenje s razumijevanjem. Učenje s razumijevanjem podrazumijeva mogućnost da se stečeno znanje primijeni u novom kontekstu.; 2. Stalnim mijenjanjem tehnologije postojeća znanja nisu dovoljna, već je potrebno učenje novih znanja koja će biti ključna u budućnosti.; 3. Metakognitivne vještine omogućuju samostalno učenje koje zahtjeva svijest o vlastitom znanju i kako to znanje proširiti.

Istraživanje Howard, McGee, Shia i Hong (2000; 2001) pokazalo je da su metakognicija i sposobnosti dva različita konstrukta te visok stupanj metakognitivne samoregulacija može kompenzirati niže sposobnosti u uspješnosti rješavanja problemskih zadataka.

Cilj ovog istraživanja je provjeriti mogućnost predviđanja školskog uspjeha na temelju stupnja kognitivnog i metakognitivnog razvoja.

Metoda

Sudionici

U istraživanju su sudjelovala ukupno 172 učenika 7. i 8. razreda osnovnih škola. Ukupno je sudjelovalo 83 dječaka i 82 djevojčice. 11 učenika je isključeno iz obrade. Iz obrade smo isključili učenike za koje nismo uspjeli prikupiti sve podatke, a to se

događalo u razredima u kojima smo prikupljanje podataka provodili prvi ili zadnji sat. Na prvi sat su neki učenici kasnili (odlazak kod doktora, zaspao i sl.) dok su za zadnji sat unaprijed dogovorili s nastavnicom da mogu otići ranije iz različitih razloga.

Instrumenti

U svrhu ovog istraživanja napravljen je posebni obrazac kojim su prikupljeni opći podatci: dob, spol, razred koji učenik pohađa, uspjeh s kojim je završio prethodni razred i prethodno polugodište, zaključna ocjena iz matematike i hrvatskog jezika na kraju prošle školske godine i na kraju prethodnog polugodišta.

Kognitivno neverbalni test – KNT (Sučević, Momirović, Fruk i Auguštin, 2004)

KNT je neverbalni test za ispitivanje logičkog zaključivanja (g – faktorski test inteligencije). Test se sastoji od 40 zadataka s crtežima geometrijskih oblika. Zadaća ispitanika je u svakom zadatku odrediti koji od 4 crteža se bitno razlikuje od ostala 3. Test je primjeren za ispitanike od 11 godina nadalje, a može se primjenjivati skupno ili individualno u trajanju od 15 minuta. Koeficijent pouzdanosti tipa unutarnje konzistencije iznosi $r_{tt} = 0,928$.

Mill Hill ljestvica rječnika – serija B za djecu (Lewis i sur., 1977; prema Križan i Matešić, ml., 2001)

Cilj Mill Hill ljestvice rječnika je zabilježiti ispitanikovu sposobnost verbalnog komuniciranja. Serija B za djecu se sastoji od 44 zadataka višestrukog izbora prikladna za djecu od 11 do 14 godina. Zadatak ispitanika je odabrati riječ, od 6 ponuđenih, koja najviše odgovara značenju zadane riječi. Cjelokupna Mill-Hill ljestvica rječnika se sastoji od serije A i serije B. Serija A sastoji se od 44 zadatka otvorenog tipa, no ona nije korištena u ovom istraživanju. Prema autorima, kada je potrebna samo gruba procjena verbalnog postignuća pojedinaca, može se primijeniti varijanta testa s česticama višestrukog izbora (varijantom otvorenog tipa dobivamo više kvalitativnih informacija). Koeficijent pouzdanosti tipa unutarnje konzistencije serije B za djecu iznosi $r_{tt} = 0,90$.

Upitnik metakognicije (Vizek-Vidović, 1995; prema Zoričić, 1995)

Upitnik metakognicije je upitnik samoprocjene kojim se ispituje samoevaluacija naučenog i traženje povratnih informacija. Upitnik metakognicije sastoji se od 14 čestica (tvrdnji), za koje ispitanik treba procijeniti na skali od 1 do 5 u kojoj mjeri se svaka pojedina tvrdnja odnosi na njega (1-nikada, 5-uvijek). Koeficijent pouzdanosti tipa unutarnje konzistencije iznosi $r_{tt} = 0,84$.

Postupak

Svi su učenici bili informirani o općim ciljevima i svrsi istraživanja te im je jasno omogućena dragovoljnost i anonimnost sudjelovanja u istraživanju. Također im je zajamčeno da će se podatci koristiti isključivo u znanstvene svrhe. Prethodno su razrednici skupili pismenu suglasnost roditelja za sudjelovanje u istraživanju.

Podatci su prikupljeni grupno, za vrijeme nastave, u trajanju od 45 minuta. Nakon što su im uputa i upitnici bili podijeljeni, eksperimentator je pročitao naglas uputu

te ih uputio u rješavanje testova inteligencije. Vrijeme rješavanja testova inteligencije bilo je ograničeno te je eksperimentator dao znak za početak i završetak rješavanja testova inteligencije. Prvo su rješavali kognitivno neverbalni test, a zatim Mill-Hill test rječnika. Vrijeme za popunjavanje Upitnika o metakogniciji i općih podataka nije bilo ograničeno. Po završetku popunjavanja upitnika učenici su mogli postavljati pitanja te su dobili kontaktni e-mail ukoliko naknadno budu imali dodatnih pitanja.

Rezultati i rasprava

Preduvjeti za provođenje parametrijske statistike i regresijske analize bili su zadovoljeni (prediktorske i kriterijske varijable su kvantitativne i na intervalnom nivou, varijance prediktora nisu nulte, ne postoji savršena multikolinearnost, tj. prediktori nisu međusobno u previsokim korelacijama, prediktori nisu povezani s „vanjskim varijablama" tj. nema treće varijable, u smislu moderatora, koja bi mogla utjecati na povezanost s prediktorima, zadovoljena je i homogenost varijance, Watson-Durbinov test je pokazao nezavisnost pogreške, tj. reziduali su u nultim korelacijama, distribucija pogreške se ne razlikuje statistički značajno od normalne distribucije, povezanost varijabli je linearna te su one nezavisno mjerene, stoga smo odlučili podatke analizirati putem hijerarhijske regresijske analize.

Tablica 1.

Pri obradi rezultata prvo smo izračunali deskriptivne statistike za varijable uključene u istraživanje. Zatim smo izračunali interkorelacije ispitivanih varijabli koje se nalaze u Tablici 2.

Za varijablu uspjeh smo koristili prosječnu vrijednost sume uspjeha s kojim je učenik završio prethodni razred i uspjeha s kojim je završio prethodno polugodište. Na isti način smo dobili varijablu uspjeh iz matematike i uspjeh iz hrvatskog jezika. Odlučili smo se za uspjeh iz hrvatskog i matematike (uz opći uspjeh na kraju godine/polugodištu) jer u osnovnoj školi učenici imaju uglavnom vrlo dobre i odlične ocjene, pa je smanjen varijabilitet u kriteriju opći uspjeh. Hrvatski jezik i matematika se obično smatraju glavnim predmetima u osnovnoj školi, te su i kriteriji stroži u odnosu na neke druge predmete, pa je za očekivati da u tim varijablama varijabilitet bude veći u odnosu na opći uspjeh. Također, ti predmeti (hrvatski i matematika) predstavljaju svojevrsnu aproksimaciju fluidne i kristalizirane inteligencije (Cattell, 1971; Horn i Cattell, 1966; Horn, 1982; prema Matešić, ml. i Zarevski, 2008). Varijable opći uspjeh, uspjeh iz hrvatskog jezika i uspjeh iz matematike su operacionalizirane kao prosječne vrijednosti ocjena na polugodištu i na kraju školske godine jer smo očekivali da bi nastavnici na kraju godine mogli imati blaži kriterij pri donošenju zaključne ocjene (npr. ako je učenik između 4 i 5, bolje da prođe s 5 nego s 4), pa se time također povećava varijabilitet. Matešić, ml. i Zarevski (2008) u istraživanju povezanosti inteligencije i osobina ličnosti sa školskim postignućem kao kriterij koriste ocjene na polugodištu zbog većeg raspona u odnosu na kraj školske godine.

Tablica 2.

Daljnja obrada se temeljila na računanju korelacija među varijablama (Tablica 2) te smo dobili da su sve korelacije značajne, osim korelacije između KNT-a i Upitnika metakognicije. Korelacije između KNT-a i školskog uspjeha (opći uspjeh, hrvatski i matematika) iznose od r = 0,4 do r = 0,45 što je potpuno u skladu s navodima Chamorro-Premuzic i Furnham (2005) da je povezanost između inteligencije i školskog uspjeha u dobi od 13 do 18 godina oko r = 0,4. Povezanost između Testa rječnika i školskog uspjeha je također oko r = 0,4, iako vidimo da je Test rječnika više povezan s uspjehom iz hrvatskog jezika r = 0,54 nego s uspjehom iz matematike r = 0,3, dok je s općim uspjehom slično kao i KNT – r = 0,47. Korelacija između KNT-a i Upitnika metakognicije nije značajna, što je za očekivati jer pretpostavljamo da su inteligencija i metakognicija dva različita konstrukta, što je u skladu s navodima Howard, McGee, Shia i Hong (2000; 2001). Također, ne postojanje značajne povezanosti može biti rezultat toga što su KNT i Upitnik metakognicije dva potpuno različita materijala, KNT je neverbalni test maksimalnog učinka, dok je Upitnik metakognicije verbalni materijal koji zahtijeva samo-procjene sudionika o tipičnom ponašanju u situacijama vezanim uz učenje. To je bio i osnovni razlog uključivanja Testa rječnika u ovo istraživanje. Korelacija između Testa rječnika i metakognicije je mala, ali značajna (r = 0,206; p<0,01), što smo očekivali jer se u ovom slučaju radi o verbalnom materijalu u oba slučaja, a i za neke čestice u Upitniku metakognicije se može očekivati da će biti povezane sa sposobnošću verbalnog komuniciranja (primjer čestica: *Ako mi je nešto nejasno dok čitam, više puta se vraćam na istu rečenicu, odlomak* ili *Provjeravam jesam li dobro razumio/la pojmove (riječi)).* Ipak, s obzirom na to da se radi o niskoj povezanosti, možemo zaključiti da se i u ovom slučaju potvrđuje hipoteza o metakogniciji i inteligenciji kao dva zasebna konstrukta. Kako su i Test rječnika i metakognicija i u značajnoj korelaciji s općim uspjehom (r = 0,468; p=<0,01 i r = 0,287; p<0,01), izračunali smo parcijalnu korelaciju za metakogniciju (uz kontrolu Testa rječnika) kako bismo provjerili objašnjava li metakognicija (uz Test rječnika) dodatni dio varijance školskog uspjeha. Pokazalo se da se korelacija smanjila, ali je i dalje značajna (r = 0,22; p<0,01), što nam govori u prilog pretpostavci da je metakognicija također važna u objašnjenju školskog uspjeha.

Kao što smo već napomenuli, u ovom istraživanju cilj nam je bio odrediti u kojoj mjeri je moguće predvidjeti školski uspjeh na temelju uspjeha na testovima inteligencije i rezultata na upitniku metakognicije kod učenika sedmih i osmih razreda osnovne škole. Dakle, prediktori u ovom istraživanju su bili inteligencija i metakognicija, a kao kriterij, uz opći uspjeh, uzeli smo u obzir i uspjeh iz hrvatskog jezika i matematike. U skladu s tim provedene su tri hijerarhijske regresijske analizu kako bismo odredili u kojoj mjeri inteligencija i metakognicija predviđaju školski uspjeh učenika viših razreda osnovne škole. Hijerarhijske regresijske analize razlikovale su se s obzirom na korišteni kriterij. U prvom koraku, u sva tri slučaja, uključeni su Test rječnika i KNT, a u drugom koraku metakognicija (kako bismo provjerili u kojoj mjeri metakognicija dodatno doprinosi objašnjenju prediktora).

Za opći uspjeh, rezultati su pokazali da prediktori zajedno predviđaju 34% varijance, od toga 30% objašnjava inteligencija (KNT i Test rječnika), dok dodatnih 4% varijance objašnjava metakognicija (tablica 4). Najboljim prediktorom općeg uspjeha pokazao se Kognitivno neverbalni test.

Tablica 3.

U slučaju kada smo kao kriterij uzeli uspjeh iz hrvatskog jezika, ukupno je objašnjeno 37% varijance, 33% varijance objašnjava inteligencija, a 4% metakognicija (Tablica 4). U ovom slučaju se najboljim prediktorom pokazao Test rječnika, zatim KNT, pa upitnik metakognicije.

Tablica 4.

Kada smo kao kriterij uzeli uspjeh iz matematike, ukupno je objašnjeno 25,7% varijance, 22,5% varijance objašnjava inteligencija, a 3,2% metakognicija (Tablica 5). Matematiku najbolje predviđa KNT, zatim upitnik metakognicije, pa Test rječnika.

Tablica 5.

Možemo reći da, općenito, testovi kognitivnih sposobnosti bolje predviđaju školski uspjeh od metakognicije, što smo i očekivali s obzirom na to da su kognitivne sposobnosti najbolji pojedinačni prediktor školskog uspjeha. Zanimljivo je da se kod općeg uspjeha najboljim prediktorom pokazao KNT, zatim Test rječnika, a nakon toga metakognicija, uspjeh u hrvatskom jeziku najbolje predviđa Test rječnika, zatim KNT, pa upitnik metakognicije, dok uspjeh u matematici najbolje predviđa KNT, zatim upitnik metakognicije, pa Test rječnika. Možemo reći da su ovakvi rezultati u skladu s očekivanjima, s obzirom na to da se može pretpostaviti kako će uspjeh u hrvatskom jeziku najbolje predviđati verbalne sposobnosti, dok su za matematiku možda važnije vještine evaluacije i monitoringa (metakognicija) od verbalnih sposobnosti. Važnost metakognitivnih vještina u rješavanju matematičkih zadataka navodi i Veenman (2005). Isti autor zajedno sa Stel-om (2008) provodi istraživanje o vezi inteligencije i metakognicije s uspješnosti u zadatku iz povijesti i matematike kod dvanaestogodišnjaka. Pokazalo se da inteligencija samostalno objašnjava 5,2% varijance uspjeha u zadatku iz povijesti, a 15,2% uspjeha u zadatku iz matematike. Metakognicija samostalno objašnjava 28% varijance uspjeha u zadatku iz povijesti, a 10,9% uspjeha u zadatku iz matematike. U ovom slučaju metakognicija je mjerena verbalnim protokolima dobivenim *pričanjem na glas* što mnogi autori smatraju najboljom mjerom metakognicije (npr. Sandi-Ureña, 2008). Desoete (2007) je koristio više mjera metakognicije u predviđanju uspješnosti na testu iz matematike kod učenika nižih razreda osnovne škole, a najboljim se pokazala mjera procjene učitelja o učenikovim metakognitivnim vještinama i pokazalo se da objašnjava 22% varijance uspjeha na testu iz matematike. Možemo pretpostaviti da je nizak postotak objašnjenja varijance školskog uspjeha Upitnikom metakognicije u našem istraživanju djelomično rezultat problematičnosti mjerenja ovog koncepta, osobito

mjera samoprocjene. Problem je u oslanjanju na sposobnost sudionika da se prisjeti i rekonstruira iskustva u učenju i rješavanju zadataka. Drugi problem (koji je uobičajen za upitnike samoprocjene) je problem referentne točke koji sudionik uzima pri procjeni i davanje socijalno poželjnih odgovora. U tom slučaju odgovor sudionika može biti pod utjecajem njegovih očekivanja i percepcije što drugi očekuju od njega (Thorndike, 2005; prema Sandi-Ureña, 2008).

Zaključak

Možemo zaključiti da su se kognitivne sposobnosti pokazale kao dobar prediktor školskog uspjeha, što je u skladu s prijašnjim istraživanjima (Nieser i sur., 1996). Metakognicija, kao noviji koncept, također se pokazala značajnim prediktorom i to za sva tri kriterija (opći uspjeh, hrvatski i matematiku), iako je jasno da pomoću nje nismo uspjeli objasniti veliki dio varijance školskog uspjeha (3-4%). Možemo pretpostaviti da bi bolje mjere (ili korištenje više mjera) metakognicije pokazale i veći doprinos objašnjenju školskog uspjeha, što ima važne implikacije za psihologiju obrazovanja jer na kognitivne sposobnosti učenika ne možemo utjecati, dok se kognitivne vještine mogu razvijati i uvježbavati te time pridonijeti boljem uspjehu učenika u različitim školskim zadatcima.