

## **How cognitive, metacognitive, motivational and emotional self-regulation influence school performance in adolescence and early adulthood**

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This contribution aims to examine how different areas of self-regulation are related to academic achievement in adolescents and young adults. The study involved participants, drawn from following age groups: 14–15, 17–18 and 22–23. In order to get information about cognitive, metacognitive, motivational and emotional aspects of self-regulation, self-report questionnaires were used. Differences between age-groups revealed following tendency: there has been a decrease in all fields of self-regulation from age of 14 (end of primary school) to the age of about 18 years (end of secondary school), and then results slowly improved to the age of about 22 years (students of undergraduate studies). The results obtained are mirroring perceived competence of self-regulation and differ from the results concerning metacognitive accuracy. Metacognitive self-regulation persists as an important predictor of school achievement at all developmental levels, and the motivational self-regulation has significant impact on performance in the first and second age group.

**Keywords:** self-regulation; school performance; adolescents; learning

Very broad definition of self-regulation comes from the field of neuropsychology: Rueda, Posner, and Rothbart (2005) claim that self-regulation refers to many processes by which the human psyche exercises control over its functions, states and inner processes.

The self-regulation is a complex construct and includes the ability to control and regulate one's own actions, cognition and emotions. It has been also defined as the ability to initiate and cease activities according to situational demands, to modulate the intensity, frequency, and duration of verbal and motor acts in social and educational settings (Bronson 2000).

The self-regulation is required when the goal-directed activities encounter obstacles and one needs to think of alternative ways of reaching the goal, when a task requires focusing of attention and irrelevant thoughts must be blocked out, etc.

Authors from information processing perspective argue that executive processes, which control thinking and action, play an important role in development of self-regulation. In problem-solving the executive functions are involved for example in problem representation, planning and evaluation (Zelazzo and Mueller 2002).

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### **Development of self-regulation**

Research shows that the ability to regulate one's own actions develops gradually over the course of childhood and adolescence, and even during adulthood. Furthermore, researchers of cognitive development argue that, with age, persons become more reflective and self-aware (Bakracevic Vukman 2005; Kuhn 2000). As a result, they become more capable than younger persons to monitor and regulate their cognitive functioning. It is supposed that, with development, self-monitoring and self-evaluations become more accurate (Demetriou and Bakracevic 2009) and cognitive, motivational and emotional functioning come under the increasing control of the individual (Demetriou and Kazi 2001).

The self-regulation gradually evolves into planfulness or strategic self-regulation, which integrates the main goals, the strategies needed to attain goals and a time plan that specifies when strategies are to be applied. This cannot be present before the age of about nine years. It is from the beginning of adolescence that persons become planful with regard to their short- and long-term goals and thus able to subordinate their thoughts and behaviour to the attainment of these goals at the age of 13 or 14 years (Demetriou 2000).

The development of self-regulation is connected, on the one hand, with maturation of specific regions in the frontal lobe and with development of attentional networks (executive control, inhibition of inappropriate impulses), and on the other hand, with social interaction and social guidance. This social support can be systematically reduced as learners gradually acquire self-regulatory skills.

### **Self-regulated learning**

Many authors in educational psychology defend the thesis that a major goal of formal education should be to equip students with self-regulatory skills (Boekaerts 1997). The self-regulation of learning is important, not only in formal schooling, but also to continue educating oneself after leaving school – for life-long learning.

According to Pintrich (2000), all models of self-regulated learning have some common assumptions:

- activity, constructivity of learners in the learning process,
- potential for control: learners can potentially monitor, control and regulate certain aspects of cognition, motivation and behaviour,
- all models of regulation assume that there is some type of criterion against which comparisons are made in order to assess whether the process should continue or a change is necessary, and
- most models also assume that self-regulatory activities are directly linked to outcomes such as achievement.

### ***Areas and phases of self-regulated learning***

Pintrich's (2000) model envisages the three areas of self-regulation (cognitive/metacognitive, motivational/affective and behavioural), which are carried out in four phases: planning, monitoring, regulation and reflection. The last one involves learners' judgments and evaluation of their performance.

There is considerable research documenting metacognition as an essential ingredient of self-directed and self-regulated learning (Cao and Nietfeld 2005). Metacognition

belongs to higher-order mental processes and enables us to control and plan our own mental activities (also to control one's own learning process). It leads us in selection and evaluation of cognitive tasks, in detection of mistakes in the problem-solving or learning process, in choosing goals and adequate problem-solving/learning strategies.

According to Zimmerman (1998), metacognition plays an important role in this process, but self-regulation also depends on self-beliefs and affective reactions. For example, perceived self-efficacy has been shown to be well suited to explain variations in personal motivation to self-regulate one's performance (Bandura 1989, 2003).

Similarly to Pintrich, Zimmerman (2000) claims that self-regulatory processes fall into three cyclical phases: forethought, self-control phase and self-reflection processes. One of self-reflective processes is self-evaluation and refers to comparing self-monitored information with a standard or goal: student assesses his/her success or failure and adapt for future learning (Isaacson and Fujita 2006; Zimmerman 1998). Actually, self-evaluation of performance is an important part of self-regulation, because we use these judgments to adjust, strategise and maximise learning.

There is a great deal of evidence that students who engage in self-regulatory processes do better in school (Pintrich 2000). Results also show that students who observe and evaluate their performance accurately can react appropriately by keeping or changing their study strategies to achieve optimal study results (Hartman 2001).

The present study intended to research influence of certain aspect of self-regulation on school performance in a developmental perspective.

## Research questions

- Are different areas of self-regulation (cognitive, metacognitive, motivational and emotional) correlated with performance?
- Do different areas of self-regulation influence performance? How much? Does this influence vary according to different developmental periods?

In addition, we researched developmental and gender differences in all the above-mentioned fields of self-regulation, and in metacognitive accuracy as an indicator of accuracy of self-evaluations in cognitive processing (as a part of self-regulation process).

According to previous research we hypothesised that:

- all forms of self-regulation will improve with age;
- girls will be more self-regulated than boys;
- cognitive and metacognitive self-regulation will influence school performance; the same will be true for motivational self-regulation; lower impact is expected for emotional self-regulation; and
- the influence of self-regulation on performance will vary according to different developmental periods.

## Methodology

### *Sample*

Age group 1: 110 primary school pupils aged 14–15; 50% females, 50% males;

Age group 2: 116 grammar school students aged 17–18; 60% females, 40% males;  
 Age group 3: 107 university students aged 22–23; 70% females, 30% males.

### ***Instruments***

- Scales for measuring cognitive and metacognitive self-regulation were constructed on the basis of Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al. 1991); Cronbach's alpha = 0.73 (for cognitive strategies scale) and Cronbach's alpha = 0.76 (for metacognitive self-regulation scale).
- Scale for measuring motivational self-regulation (goal orientation, control beliefs, self-efficacy, effort regulation) was constructed on the basis of MSLQ (Pintrich et al. 1991) and self-efficacy scale (Schwarzer and Jerusalem 1995); Cronbach's alpha = 0.83.
- Scale for emotional regulation was adapted according to Emotional Regulation Questionnaire (Taksic 2001; constructed on the basis of Mayer, Salovey and Caruso test of emotional intelligence); Cronbach's alpha = 0.74.

All of the above-mentioned instruments are self-report questionnaires. To find out, if there are correlations between self-reported self-regulatory skills, and metacognitive accuracy in evaluation of performance (regarding as a step in self-regulation process), we also used three tasks of verbal logical reasoning (Demetriou and Kazi 2001) and self-evaluation of performance scale.

School performance was measured by student's school-grades (GPA).

### ***Procedure***

Firstly, participants filled in the above-mentioned self-report questionnaires. Afterwards, they solved three tasks from the field of verbal – propositional reasoning. After solving each task, the participants were asked to evaluate their performance on the task in reference to a seven-point scale. The participants were asked the following question: "How correct you think your answer is?" The seven-point scale in regard to this question varied from 1 (it was completely wrong) to 7 (it was absolutely correct). Time was not limited, but the whole procedure did not take more than one hour.

To get an indicator of metacognitive accuracy, we created a self-evaluation accuracy index (SEAI) by combining actual performance with self-evaluation. Specifically, we defined as accurate self-evaluation the condition where success on a given task was associated with a score of 6 or 7 on the self-evaluation scale and failure on the task was associated with a score of 0 or 1. Any other combination of actual performance and self-evaluation was considered to be inaccurate or unclear self-evaluation.

### ***Statistical analysis***

- ANOVA and Student's *t*-test were used for testing differences between age and gender groups; when the Levene test of homogeneity of variances proved significant, Tamhane post-hoc test for unequal variances was applied to identify significant differences between groups;

- Correlation was performed to examine the relationship between different areas of self-regulation and school performance;
- Multiple regression analysis was used to assess combined influence of self-regulation on school performance.

## Results

As can be seen in Table 1, the primary school pupils were significantly better in almost all fields of self-regulation than the secondary/grammar school students and the university students. The biggest differences are shown in metacognitive and emotional self-regulation, where the primary school pupils obtained significantly higher values ( $M = 3.81$ ;  $M = 3.97$ ) than the grammar school students ( $M = 3.57$ ;  $M = 3.58$ ) and the university students ( $M = 3.60$ ;  $M = 3.64$ ). In motivational self-regulation, only the difference between the primary school pupils ( $M = 3.25$ ) and the secondary school students ( $M = 3.03$ ) was statistically significant.

Metacognitive accuracy presents us with another picture: the best results in SEAI were obtained in the student group ( $M = 1.50$ ), both other groups performed significantly worse ( $M = 1.63$ ;  $M = 1.60$ ; see Table 1).

Table 2 presents us with gender differences in all studied areas of self-regulation. The only significant difference between males and females is obtained for metacognitive self-regulation, where girls ( $M = 3.73$ ) outperformed boys ( $M = 3.54$ ) in total sample ( $t = -2.60$ ;  $p < .01$ ). Cognitive, motivational and emotional self-regulation were not significantly different.

However, we were interested whether gender differences are similar in all age groups, and if not, which direction the changes will take. Thus, comparisons of gender differences in all age groups regarding self-regulation are presented in Table 3.

Differences in self-regulation between boys and girls were significant mainly in the age group 1: girls were significantly better than boys in cognitive ( $M = 3.98$ ;  $M = 3.55$ ), metacognitive ( $M = 3.98$ ;  $M = 3.64$ ) and emotional ( $M = 4.11$ ;  $M = 3.82$ )

Table 1. Means and standard deviations in different age groups for different areas of self-regulation and metacognitive accuracy and post-hoc multiple comparisons for observed means (Tamhane post-hoc test).

	Age groups						Sign. diff. between groups
	Group 1		Group 2		Group 3		
	M	(SD)	M	(SD)	M	SD	
Self-regulation							
Cognitive SR	3.77	(.70)	3.58	(.59)	3.68	(.55)	—
Metacognitive SR	3.81	(.72)	3.57	(.60)	3.60	(.53)	(G1, G2)** (G1, G3)*
Motivational SR	3.25	(.44)	3.03	(.44)	3.17	(.43)	(G1, G2)*
Emotional SR	3.97	(.64)	3.58	(.64)	3.64	(.60)	(G1, G2)*** (G1, G3)**
Metacognitive Accuracy	1.63	(.38)	1.60	(.27)	1.50	(.25)	(G1, G3)** (G2, G3)**

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

Note: The acronyms within the parentheses indicate the groups among which significant differences in the means were found. In metacognitive accuracy, lower value means better result.

Table 2. Means and standard deviations in different gender groups for different areas of self-regulation, and results of *t*-test regarding gender differences in whole sample.

Self-regulation	Gender				Test	Sign.
	Males		Females			
	M	(SD)	M	(SD)		
Cognitive SR	3.58	(.66)	3.72	(.58)	-2.24	.13
Metacognitive SR	3.54	(.64)	3.73	(.61)	-2.60	.01**
Motivational SR	3.13	(.45)	3.16	(.44)	.66	.51
Emotional SR	3.68	(.65)	3.76	(.65)	-.98	.32

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

Table 3. Gender differences in cognitive, metacognitive, motivational and emotional self-regulation in different age groups (*t*-test).

Self-regulation	Age groups						Sign. Gender diff. in following groups
	Group 1		Group 2		Group 3		
	M	F	M	F	M	F	
Cognitive SR	3.55	3.98	3.54	3.61	3.70	3.67	G1**
Metacognitive SR	3.64	3.98	3.45	3.64	3.51	3.64	G1**, G2*
Motivational SR	3.19	3.31	3.02	3.04	3.18	3.16	–
Emotional SR	3.82	4.11	3.55	3.60	3.62	3.65	G1*

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

self-regulation. In the age group 2, significant differences in favour of girls were found just in metacognitive self-regulation ( $M = 3.64$ ;  $M = 3.45$ ), and in the age group 3 gender differences were not statistically significant any more.

In Table 4, correlation coefficients show connections between different fields of self-regulation and school performance in all age groups. It is obvious that in the age group 1 all correlations are significant. In this group, the highest correlation was obtained between metacognitive self-regulation and school performance ( $r = 0.54$ ,  $p < .001$ ), followed by correlation between cognitive self-regulation and performance ( $r = 0.45$ ,  $p < .001$ ) and motivational self-regulation and performance

Table 4. Correlations between cognitive, metacognitive, motivational and emotional self-regulation, and school performance.

Self-regulation	School performance in groups			
	Group 1	Group 2	Group 3	Total sample
Cognitive SR	0.45***	0.10	0.24*	0.31**
Metacognitive SR	0.54***	0.41***	0.31**	0.46***
Motivational SR	0.43***	0.21*	0.02	0.28**
Emotional SR	0.26*	0.01	0.08	0.16*

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .

( $r = 0.43, p < .001$ ). Emotional self-regulation showed lower correlation with performance ( $r = 0.26, p < .05$ ).

In other two age groups, mainly the metacognitive area was significantly correlated with the school performance (G 2:  $r = 0.41, p < .001$ ; G 3:  $r = 0.31, p < .01$ ). Additionally, in the age group 2 also the correlation between motivational self-regulation and performance proved to be significant ( $r = 0.21, p < .05$ ) and in the age group 3 the cognitive area was significantly connected with the school success ( $r = 0.24, p < .05$ ).

As it can be seen in Table 5, the results of multiple regression analysis revealed that included predictors presented by  $R^2$  all together account for 34% of the variance of the criterion in the first age group, for 21% in the second group and only for 14% of the variance in the third age group. Predictors also differ according to their impact on the criterion and its effect size. Therefore, the metacognitive self-regulation is the only area among the investigated ones which has a statistically significant influence at all ages. The influence of this predictor is highest in the second age group consisting of the secondary school students ( $\beta = 0.50, p < .001$ ), slightly lower in the age group 1/primary school students ( $\beta = 0.46, p < .001$ ) and the lowest though statistically significant influence of metacognitive self-regulation on the school performance is present in the group 3 ( $\beta = 0.25, p < .05$ ) – group of university students.

This predictor is followed by motivational area of self-regulation, which has high statistically significant influence on the school performance in the age group 1 ( $\beta = 0.42, p < .001$ ) and lower, but still significant influence on the school success in the second age group ( $\beta = 0.21, p < .05$ ). The role of cognitive and emotional self-regulation proved to be less significant (statistical characteristics of regression model:  $F = 16.78, p < .001$ ).

Additionally, a correlation between the self-reported ability of self-regulation in metacognitive area (questionnaire) and the metacognitive accuracy in problem-solving (SEAI) has been determined. The results revealed rather low but significant correlation between the self-reported metacognitive self-regulation and the metacognitive accuracy in problem-solving ( $r = 0.13, p < .05$ ).

## Discussion

Differences between age groups revealed a very interesting tendency which was opposite to our expectations: although we hypothesised that all forms of self-regulation will

Table 5. Results of multiple regression analysis of the influence of different areas of self-regulation as predictors of school performance as a criterion, and parts of variance of school performance in groups which is explained by these predictors ( $R^2$ ).

Predictors	Regression coefficient beta			Total
	Group 1	Group 2	Group 3	
Cognitive SR	-0.05	-0.17	0.06	-0.03
Metacognitive SR	0.46***	0.50***	0.25*	0.41***
Motivational SR	0.42***	0.21*	–	0.28**
Emotional SR	-0.04	–	–	–
Parts of Variance ( $R^2 \times 100$ )	34%	21%	14%	

\* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .



improve with age, there has been a decrease in all fields of self-reported self-regulation from age of 14 (age group 1 which involved pupils at the end of primary school) to the age of 17–18 years (age group 2 – near the end of secondary/grammar school) and then the results slowly improved to the age of about 22 years (age group 3 included students at the end of undergraduate studies). According to developmental research, the self-regulation should develop and improve with age and reach the level of planfulness at the beginning of adolescence (Demetriou 2000). Actually, our control variable, metacognitive accuracy or accuracy of self-evaluation of performance, which represents an important step in cognitive/metacognitive self-regulatory process and was considered as an indicator of “real” ability of self-regulation, proved that the metacognitive ability is actually improving during this period. Most probably, the reason for much lower results in self-reported self-regulation ability at the age of 17–18 goes back to the fact that the questionnaires we used (and this is true for most self-report questionnaires) actually measure perceived self-regulation. Thus, the obtained results are mirroring perceived competence in different areas of self-regulation. Here, we must take into account that the decrease in the perceived competence during adolescence could be consequence of developmental characteristics of adolescents, which may result in lower self-appraisals. The younger pupils were obviously more optimistic in their self-evaluations. But it is also possible that lower results in the older groups reflect automaticity – because the older students have automatized more of self-regulative processes than younger, they may not be aware so much that they engage in these processes. Another reason could be the effect of schooling: reported decrease in self-regulation which was found at the end of secondary school could also be an effect of the school environment. It is necessary to mention that pupils in the age group 2 were attending a highly demanding grammar school. Of course, it would be helpful to know something more about the social climate and teaching methods in the school, but these data were not collected for this study. Certainly, comparison of students, following different schooling tracks, would be helpful. A good description of dynamic changes in self-image is so-called “big-fish-little-pond effect”, described by Marsh et al. (2007). This effect actually emphasises the meaning of frame-of-reference in educational settings and according to it, attending academically selective high schools negatively affects academic self-concept.

Regarding gender differences in general, girls were more self-regulated than boys; but there was again interesting developmental tendency which showed that differences between males and females gradually disappear. In primary school, gender differences in almost all fields of self-regulation were significant (in favour of girls); in study years (young adulthood) there were no differences any more. Is the development of self-regulation in males a characteristic of late adolescence and young adulthood, while girls develop the self-regulation mechanisms earlier? There is certainly a need for more longitudinal studies in this field.

Correlations between metacognitive self-regulation and school performance were statistically significant in all age groups, this variable had also the strongest impact on school performance in all groups, comparing to the other forms of self-regulation. Thus, it is possible to state that metacognitive self-regulation persists as an important predictor of school achievement at all levels of education. The motivational self-regulation showed significant influence on school performance in the group of primary school pupils and lower, but still significant influence in the group of secondary school students. An important role of self-efficacy beliefs (which were part of motivational self-regulation) in prediction of academic success was shown also in



some other studies, where transition from elementary to secondary school was examined (Bouffard, Boileau, and Veau 2001, Bouffard and Couture 2003). But, interestingly, the motivational self-regulation did not show significant influence on performance in the group of undergraduate university students. However, the cognitive and emotional self-regulation were not important predictors in any of the age groups.

Analysis of influence of all predictors together revealed that different areas of self-regulation could explain 34% of variance of school performance in the primary school, about 21% in the secondary school and nearly 14% in the university education. We actually expected that the role of self-regulation will become more important at higher levels of education, where educational environment is not so well structured and students have to regulate their study activities more independently. The reason that self-regulation explains lower parts of variance of school success at higher educational levels could be the fact that at the higher developmental and educational stages certain level of self-regulation is already developed and there are no big differences in this regard between the students any more (standard deviations in cognitive and metacognitive self-regulation are lower in the age groups 2 and 3 than in the age group 1; see Table 1); groups at higher educational levels are also more homogenous in ability than groups in compulsory education.

When comparing the metacognitive self-regulation, measured by self-report questionnaire and the metacognitive accuracy in problem-solving (SEAI), the correlation is statistically significant but not very high. While the first variable is strongly connected with school performance, the second one is not. This could indicate that the self-representation of ability of self-regulation is more important for the school success than “real” metacognitive self-regulation. We could claim that these findings are in line with the view about the primary role of self-perceptions of competence in achievement (Bandura 1989). Nevertheless, it is obvious that different methodologies and instruments for measuring metacognitive self-regulation are not measuring exactly the same phenomena. Here, for example, a correlation between the results of the questionnaire measuring (self-reported) use of metacognitive self-regulation, and the accuracy of the evaluation of solution in problem-solving, which is considered as a step in the metacognitive self-regulatory process, was lower than expected. To have a clearer picture about the divergence of different methodologies, a more comprehensive comparison would be needed.

### Notes on contributors

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