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METACOGNITIVE MONITORING IN THE SELF-REGULATED LEARNING PARADIGM

Abstract

The paper is focused on the theoretical analysis of some theoretical and methodological aspects of the role and importance of metacognitive monitoring in the self-regulated learning paradigm of university students. In particular, we highlight some approaches to the relation between metacognitive monitoring and students' self-regulation that is a quite common problem in the university learning activity. Moreover, we also aim at revealing the diverse approaches to the definition of metacognitive monitoring, specifying the nature of relationship between metacognitive monitoring and metacognitive control. The theoretical and comparative methods of studying the role and significance of metacognitive monitoring in the self-regulated learning paradigm have been taken into account. Thus, we tend to consider metacognitive monitoring as the process of assessing the on-going progress and its results in learning, as well as the current state of students' particular cognitive activity. The accuracy of metacognitive monitoring judgments strongly affects self-regulated learning. Accurate metacognitive monitoring produces more effective regulation, and this, in turn, leads to improved learning. A noteworthy finding is that through properly organized accurate metacognitive monitoring students can at the metacognitive level study cognitive features of knowledge acquisition and the use of learning strategies. Metacognitive control is also central to metacognition. Both monitoring and control form the basis for many theories of self-regulated learning. Inaccurate monitoring is connected to control decisions that are misaligned to learning requirements or task demands. The presented ideas can expand an investigation of metacognitive monitoring accuracy in the learning activity of university students.

Key words*: learning activity; metacognition; metacognitive monitoring; self-regulated learning, students.*

Introduction. Metacognitive monitoring of one's own cognitive processes plays an important role in the structure of metacognition. It is measured with the help of the level of the judgments of learning accuracy and the calibration of confidence in knowing procedure. Moreover, metacognitive monitoring plays a key role in the development and enhancing self-regulated learning in general, and especially self-regulation of university students' learning activity. Metacognitive monitoring affects regulation of study, and this affects overall learning (Thiede et al., 2003). It falls under the regulation facet of metacognition and in the process of performing a specific task refers to one's awareness of comprehension and performance.

Metacognitive monitoring judgments of learning show whether a student is approaching the correct solution to a problem and assess how well he/she understands what is being learned (Dunlosky & Metcalfe, 2009). Students' ability to monitor their learning is one of the key building blocks in self-regulated learning (Isaacson & Fujita, 2006).

There is a need to specify the diverse approaches to metacognitive monitoring definitions. The main characteristics of metacognitive monitoring as the regulatory aspect of metacognition, structural components, types and the role in the learning activity are studied by numerous foreign (K. Bahbahani, L. Baker, S. Berry, L. Bol, A. Brown, R. Dennison, J. Dunlosky, A. Efklides, G. Everson, J. Flavell, A. Fomin, D. Hacker, M. Händel, A. Koriat, F. Kuch, J. Metcalfe, L. Narens, T. Nelson, J. Nietfeld, E. Savin, J. Ranalli, G. Schraw, M. Serra, K. Thiede, S. Tobias, A. Valdez, A. Was, etc.) and Ukrainian researchers (M. Avhustiuk, E. Balashov, T. Dotsevych, R. Kalamazh, I. Pasichnyk, O. Shovkova, O. Tkachuk, V. Voloshyna, and others).

The significant role of metacognitive monitoring in self-regulated learning is undoubtful. Nevertheless, the questions of the diversity of metacognitive monitoring definitions, as well as metacognitive monitoring implications in the self-regulated learning paradigm, still need thorough investigation. Moreover, the analysis of the psychological literature has shown some significant aspects of interrelation between students' metacognitive monitoring and self-regulation needed to be taken into consideration.

Thus, the aim of the paper is a theoretical framework of some theoretical and methodological aspects of the role and importance of metacognitive monitoring in the self-regulated learning paradigm.

Methodology and methods. The theoretical and comparative methods of studying the role and significance of metacognitive monitoring in the self-regulated learning paradigm have been taken into account. The necessity in studying such correlation has been caused by its importance in learning activity.

Results of the research. The analysis of the studies of metacognitive monitoring peculiarities has shown that the notion is seen as an assessment or estimation of individual's own knowledge, knowledge of cognitive strategies, and

knowledge of conditions that affect the learning process (studies by M. Avhustiuk, J. Dunlosky, A. Fomin, R. Kalamazh, J. Metcalfe, D. Moshman, L. Narens, T. Nelson, I. Pasichnyk, Ye. Savin, G. Schraw, M. Serra, etc.). In the learning activity metacognitive monitoring is viewed as the way of evaluation of students' cognitive activity and how these results direct to the solution of certain cognitive tasks (recalling answers, doing tests, and reading texts) (studies by Ye. Savin and A. Fomin, etc.).

Significantly, metacognitive monitoring is regarded by some researchers as a skill (studies by A. Fomin, R. Isaacson, Ye. Savin, G. Schraw, C. Was, etc.), particularly, the skill that can be taught and learned (Ranalli, 2018; etc.), while others are even more concrete in specifying that metacognitive monitoring is the ability to provide progress assessment (studies by H. Clark III, J. Flavell, I. Pasichnyk, O. Shovkova, S. Ward, and others). A number of the authors see it as a process (studies by M. Avhustiuk, R. Isaacson, R. Kalamazh, J. Metcalfe, I. Pasichnyk, M. Serra, C. Was, etc.). The important role is played by the sphere of metacognitive monitoring use. In Table 1 we provide the summarized ideas found in the psychological literature towards the diverse nature of metacognitive monitoring definitions.

Table 1

Definitions of Metacognitive Monitoring

Concept	**Author(s)**	**Nature of Assess-ment**	**Definition**	**Examples**
Cognitive monitoring	J. H. Flavell	ability (skill)	the ability by which people can monitor their own cognitive and affective states	Occurs through the actions of and interactions among its four classes: metacognitive knowledge, metacognitive experiences, goals (or tasks), and actions (or strategies).
Comprehensio n monitoring	S. B. Ward & H. T. Clark III	ability (skill)	the ability to regulate on-going comprehension processes	Provides information which a learner may use to make decisions about areas of study, level of understanding, and to detect when further clarification is needed.
Metacognitive monitoring	T. O. Nelson & L. Narens	process	the process of evaluation of cognitive activity and its results	The meta-level is informed by the object-level; the main methodological tool for generating data about metacognitive monitoring consists of the person's subjective reports about his/her introspections.

Metacognitive monitoring	G. Schraw & D. Moshman; G. Schraw	ability (skill)	the awareness of understanding (comprehension) and task performance	The engagement in periodic self-testing while learning.
Monitoring one's own knowledge during study	A. Koriat	ability (skill)	the cue-utilization approach to judgments of learning	Is based on the distinction between three general classes of cues for JOLs: intrinsic, extrinsic, and mnemonic.
Metacognitive knowledge monitoring	S. Tobias & H. T. Everson	ability (skill)	the awareness of what is known and unknown, and is the basis for other metacognitive activities, such as evaluating learning, selecting appropriate strategies or planning; it is a crucial component in most learning and instructional contexts	The basic strategy is to assess knowledge monitoring processes (the KMA) by evaluating the discrepancy between students' estimates and their actual knowledge or ability determined by performance on a test.
Metacognitive monitoring	K. W. Thiede, M. C. M. Anderson, & D. Therriault	ability (skill)	the ability that affects regulation of study, and this affects overall learning	Accurate metacognitive monitoring can produce more effective regulation, and this, in turn, can produce improved learning (higher levels of test performance)
Metacognitive knowledge monitoring	R. M. Isaacson & F. Fujita	ability (skill)	the ability to assess the mastery of the learners' academic tasks they are facing	To examine the relationship between metacognitive knowledge monitoring (MKM) of classroom performance and academic success.
Metacognitive monitoring	M. Serra & J. Metcalfe	process	the assessment that focuses on the progress of the cognitive processes in which a person is engaged	Can take the form of explicit judgments – feeling-of-knowing judgments (FOKs), ease-of-learning judgments (EOLs), confidence-in-response judgments, etc.
Metacognitive monitoring	J. Dunlosky & J. Metcalfe	ability (skill)	the assessment (or evaluation) of the current state of a cognitive activity	To judge whether you are approaching the correct solution to a problem; to assess how well you understand what you are reading/learning.
Metacognitive knowledge monitoring	R. M. Isaacson & C. A. Was	ability (skill)	a skill of assessing the prior knowledge that can be taught and learned	To examine students' ability to monitor and accurately assess their prior knowledge.
Metacognitive monitoring	A. Valdez	process	a process that consists of various critical determinants of human learning	To use various knowledge estimates to enable learners to engage in self-regulatory processes important for both the acquisition of knowledge and the monitoring of one's knowledge when engaged in assessment.

Metacognitive monitoring	Ye. Savin & A. Fomin	ability (skill)	the skill of checking out the process and the result of any cognitive activity	Is done on the way of checking out students' cognitive activity and how these results direct to the solution of certain cognitive tasks (such as recalling answers, doing tests, and reading texts).
Metacognitive monitoring	M. Avhustiuk, I. Pasichnyk & R. Kalamazh	process	the process of assessing the on-going progress and its results in learning, as well as the current state of students' cognitive activity	Metacognitive monitoring reliability (accuracy) is studied through the prism of the effects of different types of information proposed to learn, and of personal, cognitive, metacognitive, and individual psychological characteristics.
Metacognitive monitoring	J. Ranalli	process	a process in which there originates one's sense of one's current state of knowledge or performance	Monitoring informs control that there is the enactment of decisions about maintaining, altering, or abandoning one's approach to learning; when monitoring is not accurate, control is based on suboptimal information, making desired task outcomes harder to achieve
Metacognitive monitoring	O. Shovkova & I. Pasichnyk	ability (skill)	the students' ability to imagine the possibilities and limits of their own cognition in the process of solving various cognitive and educational problems and to understand the level of the effectiveness of the preparation used to regulate educational and cognitive activities	Is studied in the process of learning activities.
Metacognitive monitoring	E. Balashov	ability (skill)	the learners' ability to evaluate the process and the results of coping with any cognitive task, in other words, to assess one's own knowledge	Is studied in the self-regulated learning paradigm of university students' learning activities.

Self-regulated learning refers to our ability to understand and control our learning environments (Schraw et al., 2006). Three main components of self-regulated learning are cognition, metacognition, and motivation. Consequently, cognition is regarded as the skills necessary to encode, memorize, and recall

information; metacognition refers to the skills that enable learners understanding and monitoring of their cognitive processes; and, finally, motivation is seen as the beliefs and attitudes that affect the use and development of cognitive and metacognitive skills (Schraw et al., 2006) (for a more detailed description of the components see Table 2 where there are shown the main aspects of self-regulated learning scheme adapted from G. Schraw, A. Bandura, J. Dunlosky, J. Metcalfe, etc.). A noteworthy finding is that the authors point out that for self-regulation each of the three components is necessary, but not sufficient.

Table 2

Self-Regulated Learning Components

Self-Regulated Learning		
Cognition	**Metacognition**	**Motivation**
(symbolic mental activities and mental representations; put differently, the skills necessary to encode, memorize, and recall information)	(cognitions about other cognitions; in other words, the skills that enable learners' understanding and monitoring of their cognitive processes)	(beliefs and attitudes that affect the use and development of cognitive and metacognitive skills)
Simple cognitive strategies: 1) student-generated questions; 2) active learning strategies (graphs and tables); 3) cloze assessment tasks.	***Knowledge of cognition*** (or ***metacognitive knowledge***) (knowledge about how learning operates and knowledge about how to improve learning): 1) declarative knowledge (knowledge, skills, and strategies essential for accomplishing a task successfully under various conditions; in other words, it is knowledge about *what* is important); 2) procedural knowledge (knowledge *how* to apply procedures such as learning strategies or actions to effectively use declarative knowledge and achieve goals); 3) conditional knowledge (knowledge *when*, *where*, and *why* to apply various procedures, skills, and cognitive actions or strategies).	***Self-efficacy*** (the degree to which an individual is confident that he/she can perform a specific task or accomplish a specific goal. It affects the extent to which learners engage and persist at challenging tasks)
Problem solving strategies: 1) predict-observe-explain technique (POE), etc.	***Metacognitive experience*** (or ***metacognitive monitoring***) (the assessment of a current state of cognitive activity): 1) judging whether you are approaching the correct solution to a problem; 2) assessing how well you understand what you are reading/learning. ***Judgments*** (ease-of-learning judgments (EOL), judgments of learning (JOLs), confidence judgments, etc.) and ***feelings*** (feelings of familiarity, of difficulty, of knowing, of confidence, of satisfactions, etc.)	***Epistemology*** (the beliefs about the origin and nature of knowledge) There exist such aspects: 1) the number of distinct beliefs (quick learning (i.e., something is learned immediately or not at all); 2) innate ability (i.e., learning is constrained by native ability); 3) simple knowledge (i.e., most important ideas are really quite simple); 4) certain knowledge (i.e., most important ideas do not change over time).

Critical thinking (reasoning): 1) identifying the source of information; 2) analysing its credibility; 3) reflecting on whether that information is consistent with your prior knowledge; 4) drawing conclusions based on your critical thinking.	***Regulation of cognition*** (***metacognitive skills*** or ***metacognitive control***) (regulation of some aspects of a cognitive activity): 1) preparing and planning for learning (selecting appropriate strategies and allocating time and resources effectively); 2) selecting and using strategies; 3) monitoring learning (the self-testing skills); 4) orchestrating strategies; 5) evaluating learning (re-evaluating one's goals; revising predictions; consolidating intellectual gains).	
Memory facet		

Discussion. Knowledge of cognition corresponds to what learners know about themselves, strategies they use, and the conditions under which these strategies are most useful. Regulation of cognition, in its turn, corresponds to learners' knowledge about the ways they plan, implement strategies, monitor, correct comprehension errors, and evaluate their learning. Consequently, these factors are strongly interrelated and suggest that knowledge and regulation may perfectly collaborate to help students effectively self-regulate their learning. For example, those learners who possess cognitive skills but are lacking motivation to use them cannot achieve the same level of performance as the individuals with the skills and motivation to use them. At the same time, those individuals who are motivated but do not possess the necessary cognitive and metacognitive skills, usually are prone to fail to achieve higher levels of self-regulation (Schraw et al., 2006, etc.).

The issue of metacognitive monitoring in the self-regulated learning paradigm is of great importance. It can be further determined as a process to help students' arrange their own emotions, thoughts and behaviour for useful learning experience, knowledge and skills (Balashov et al., 2018).

Significantly, talking about the role of metacognitive monitoring in a paradigm of self-regulated learning, one should take into account its types. Thus, in our previous studies (Avhustiuk et al., 2018) the types of metacognitive monitoring according to the criteria of accuracy, level of performance, temporal implication, learning achievements, cognition plot, level of understanding, basis of judgements, etc. were highlighted.

B. Zimmerman's model of self-regulated learning and academic achievement highlights the importance of motivation strategies in self-regulated learning. The author suggests that students' self-efficacy and learning strategies play a crucial role in self-regulated learning (Zimmerman, 2002).

Moreover, students' self-regulated learning is quite complex notion and can be presented through a prism of integral, personal, motivational-volitional, emotional-behavioural, communicative, cognitive, and metacognitive levels (Balashov et al., 2018). Such indicators are interrelated strongly depending on the accuracy of metacognitive monitoring of students' learning activity and aiming at improving the efficiency of self-regulated learning in general.

M. Boekaerts (1999) and colleagues propose a model of classroom self-regulation. This model distinguishes two parallel processes for the purposeful direction of action: 1) top-down self-regulation (goals setting (to extend knowledge and sustain motivation), awareness (of what is known, believed, and what the differences between these kinds of information are for approaching tasks), motivation, planning, deliberate small-grain tactics, etc.); and 2) bottom-up self-regulation (when self-regulation is triggered by cues from the environment; consists of feedback from the task and classroom reward structures). An important finding from Boekaert's model of self-regulation is that it helps students become concerned with their emotional well-being.

In self-regulated learning, learners are predisposed to consistent monitoring of their progress and adaptation of their learning activities according to the results of these monitoring judgments. Consequently, based on their metacognitive monitoring judgments, students are supposed to initiate regulation process. Therefore, as P. Winne and A. Hadwin (1998) suppose, monitoring activities should affect students' future effort and learning behaviour, and should in such a way lead to higher learning performance. The thing is, however, that this interplay of metacognitive monitoring and self-regulation works smoothly only in case of higher accuracy of monitoring judgments.

The accuracy of metacognitive monitoring judgments strongly affects self-regulated learning. Accurate metacognitive monitoring is critical to learning. It

produces more effective regulation, and this, in turn, leads to improved learning. In other words, monitoring provides a basis for making decisions about what to relearn or how long to learn the needed material (Thiede et al., 2003, etc.). Moreover, more accurate monitoring can lead to more effective regulation, which, in its turn, can lead to higher levels of test performance (Thiede et al., 2003). However, as many authors state, there is no strong empirical evidence that links monitoring accuracy or self-regulation measures of learning.

Consequently, there exist many models of self-regulated learning that can be classified as discrepancy-reduction models. They state that a learning process begins with setting a desired state of learning for the material that is to be learned. During learning a student monitors how well the material has to be learned to determine the current state of learning. In case of meeting or exceeding the desired state of learning, he/she will terminate study. On contrary, if the current state of learning does not reach the desired state of learning, the learner will need to continue to study the material. During the restudy process, he/she monitors his/her learning and compares the current state of learning with the desired one. The notion is that the person will continue to master the material until the perceived discrepancy between the current state of learning and the desired state of learning reach zero (Thiede et al., 2003, etc.).

Indeed, students are predominantly inaccurate in their metacognitive judgments of their individual performance and usually tend to overestimation of their test performance. Put differently, accurate metacognitive monitoring is not always the case. The illusions of knowing and not knowing, regarded as over- and underconfidence, according to J. Dunlosky and K. Rawson (2012), pose a major threat to students' learning and achievement. With the correlations of subjective and objective success of any learning performance activity, as well as with the effective use of a complementarily mixed method design to measure metacognitive monitoring, it is possible to establish metacognitive monitoring accuracy factors, as well as to highlight its errors of assessment.

According to R. Isaacson and F. Fujita (2006), metacognitive monitoring assessments of learning are important implications for self-regulated learning as they can influence the regulation of how much time and effort students devote to studying.

Skilful self-regulators are able to go beyond the assessment of their ability to recall information; they are able to estimate how well they have learned the needed material and how well they will be able to show what they learned; moreover, they are able to predict how well or how poorly they will do or have done on a test. Put differently, students who self-regulate their learning more tend to estimation of their academic success.

A noteworthy finding is, as A. de Bruin and T. van Gog (2012) state, that laboratory-based research into metacognitive monitoring accuracy is abundant. At the same time, naturalistic studies of its accuracy, effects on self-regulation and learning outcomes are still rare.

The analysis of psychological literature has also shown that not only metacognitive monitoring is central to metacognition, but also is metacognitive control. These notions form the basis for many theories of self-regulated learning (Ranalli, 2018, etc.). Thus, according to B. Zimmerman (2002), self-regulated learning is seen as a cyclical process of students' monitoring of the effectiveness of their learning methods (or strategies) and further responding to the feedback in different ways that range from covert changes in self-perception to overt changes in their learning behaviour.

P. Winne and A. Hadwin (1998) proposed an influential self-regulated learning model of interplay between metacognitive monitoring and control. According to this model, these variables operate in four stages of learning: definition of a task, planning (or goal setting), task engagement, and post-task adaptations to goals and strategies used, etc. Inaccurate monitoring is connected to control decisions that are misaligned to learning requirements or task demands (Ranalli, 2018, etc.).

In the process of solving learning problems G. Schraw colleagues (2006), B. Zimmerman and others propose the problem solving scheme that involves the phases to self-regulation which incorporate metacognition. In our study we propose adapted from the mentioned studies Scheme of problem solving process in self-regulated learning (see Figure 1).

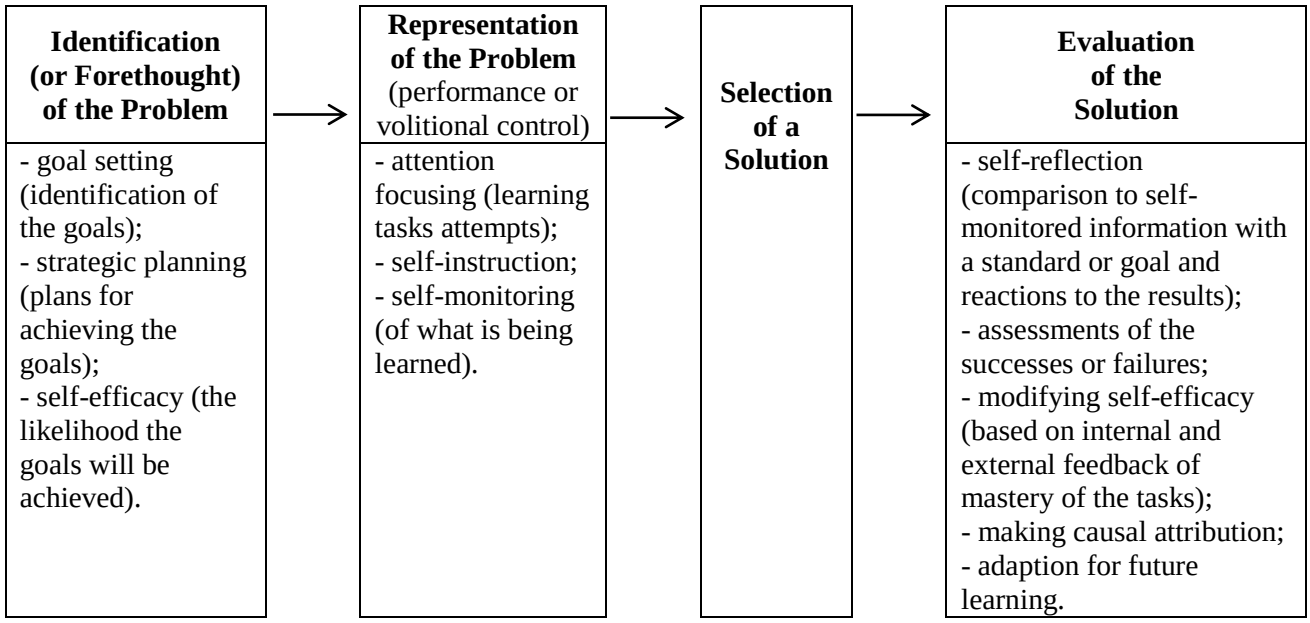

Figure 1. The Problem Solving Process Scheme

Conclusions. Thus, we tend to consider metacognitive monitoring as the process assessing the on-going progress and its results in learning, as well as the current state of students' particular cognitive activity. Theoretical analysis of the literature allows us to conclude about the importance of metacognitive monitoring in the learning process as the regulatory aspect of metacognition. The notion determines the degree of effectiveness of different learning activities, as allows not only the students' acquisition of knowledge, but also their assessment and regulation of the process of cognitive activities. Through properly organized accurate metacognitive monitoring students can at the metacognitive level study cognitive features of knowledge acquisition and the use of learning strategies. Furthermore, the presented ideas can expand an investigation of metacognitive monitoring accuracy in the learning activity of university students.

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