PSYCHOLOGY

The illusion of knowing from the indexes of confidence, calibration and resolution perspective

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Abstract. The paper contains summarized results of an analysis of the theoretical, experimental and applied research peculiarities of metacognitive monitoring as an aspect of metacognition and the illusion of knowing as a problem of effective metacognitive monitoring. Special attention is paid to the synthesis of the basic notions of the accuracy of metacognitive monitoring. The analysis made it possible to determine the impact of situational factors and individual indicators on the illusion of knowing. Special attention was paid to such indicators as an index of resolution that together with indexes of confidence and calibration characterize the illusion of knowing. The practical value of this study is associated with the ability to use its results in the educational process in order to overcome the negative impact of the illusion of knowing on the effectiveness of metacognitive monitoring.

Keywords*: calibration, illusion of knowing, index of resolution, metacognitive monitoring, subjective confidence*

Introduction. Metacognitive monitoring usually takes place when people evaluate their own cognitive processes in the sphere of learning activities according to their goals. People monitor their own cognitive processes, recognize the occurrence of any problems and concepts, and thus keep a balance between these processes and the learning methods inclined. Subjective confidence being closely related to the accuracy of judgments plays very important role in the objectivity of metacognitive judgments of comprehension and performance. Scientific references analysis showed that the problem of development of the illusion of knowing in metacognitive monitoring of the educational activity is not studied enough. Moreover, there is a strong need of creating new ways of its research, as well as to provide its systematization and theoretical generalization. The difficulty is created by the fact that many factors having strong influence on the development of the phenomenon are not studied by native scientists. To make a clear understanding of the problem there is a strong need to do detailed analyses of cognitive and individual features of the comprehension subjects, especially those correlating with the effectiveness of metacognitive monitoring.

Metacognitive monitoring processes are crucial indicators of human learning. Metacognitive monitoring consists of different so-called "assessments" of knowledge that allow subjects of the educational process to be included in the self-regulatory processes important both for receiving knowledge and monitoring this knowledge when its assessment is needed [7, p. 141]. They are so-called "metacognitive judgments" made by a subject of cognition while doing certain tasks. Confidence judgments, ease of learning judgments, judgments of learning, and feeling of knowing judgments are usually referred to them.

Analysis of recent researches and publications. The peculiarities of metacognition as the basis of metacognitive monitoring, and the main concepts of metacognitive monitoring as the regulatory aspect of metacognition, its main features and influential sphere are investigated by such researchers as J.H. Flavell, A.L. Brown, G. Schraw, S. Tobias, H.T. Everson, T.O. Nelson, L. Narens, J. Dunlosky, R.S. Dennison, D. Moshman, A. Koriat, A.P. Shimamura, J. Metcalfe, R.A. Bjork, R. Kluwe, A.V. Karpov, E.Y. Savin, T.I. Dotsevych, S.D. Maksymenko, I.D. Pasichnyk, R.V. Kalamazh, M.M. Kashapov, A.Y. Fomin,T.B. Khomulenko, I.M. Skitiaeva, A.K. Samoilichenko, and others. The main notions of the illusion of knowing as the metacognitive monitoring error were found by A.M. Glenberg, A.C. Wilkinson, W. Epstein, D.K. Eakin, L. Myers, et al. Moreover, D.K. Eakin, A. Koriat, J. Metcalfe, A.M. Glenberg, A.C. Wilkinson, W. Epstein, T.O. Nelson, L. Narens, L.M. Reder, F.E. Ritter, E.Y. Savin, A.Y. Fomin, T.I. Dotsevych, A.V. Karpov, and many others studied the functions of the illusion of knowing in metacognitive monitoring as well as its influence on the effectiveness of educational activity.

The research aim is to do theoretical justification and experimental verification of the features of the illusion of knowing in metacognitive monitoring of the educational activity of university students, and also to investigate the peculiarities and main features of the development of the illusion of knowing in metacognitive monitoring from the perspective of confidence, calibration and resolution indexes.

Methodology of research. Obviously, the origin of the illusion of knowing is a significant problem in the educational process. It is logical to assume that any information received inadequate assessment leads to poor understanding. Due to the negative impact of the emergence of the illusion of knowing on the performance of storing information it is necessary to do versatile study of this phenomenon with a view of minimization of its impact on the process of working with information. Particularly important is the study of the causes of the illusion of knowing. In particular, this aspect of the research will help more deeply understand the essence of this phenomenon. Also, knowledge of the factors of the illusion of knowing makes it possible to adjust and to influence the course of events.

In order to analyse and provide an interpretation of experimental investigation of factors of the illusion of knowing in the learning process of students a pilot study of factors of the illusion of knowing the results of which are shown below was conducted. All the data were processed by a computer program IBM SPSS Statistics 20. To analyze the statistical data we used *gamma* correlation coefficient *G*, single-factor analysis of variance and LSD-analysis.

Laboratory experiment consisted of four stages: "Information remembering", "Assesment of information", distractor, and "Recollection of information". The participants were 50 students of the National University of Ostroh Academy (14 males and 36 females, mean age 18,06; SD = 2,07). They read different texts and statements, learned word pairs, rated their confidence about the level of understanding, and answered the questions about their

understanding of the given information. The tasks needed to be solved were divided into nine groups representing each factor of the illusion of knowing. Those were open-answer questions, questions with answers "yes" / "no" / "do not know", and multiple-choice questions for texts, statements and word pairs each.

Results of research and their discussion. The first aim of the research was to check the ratings dependence between JOLs and the investigated factors such as the type of task, type of information, its style and the text level. After analyzing the performance ratings of judgments of learning (JOLs) influenced by the type of test with the help of a single factor variance statistically significant differences were not found in the mean values of ratings of JOLs about the type of test [F (2,56) = 2,602; p = 0,74]. Our results coincide with the data of M.K. de. Carvaho Filho [1] because the differences between the performance of JOLs objectivity and accuracy are more significant when dealing with issues of open-answer questions.

However, in contrast to the results obtained by S. Dutke, J. Barenberg and C. Leopold [3] who claim that knowledge of the type of test in advance contributes to its greater objectivity, we found an inverse trend that students inaccurately assessed their knowledge, and there was observed a trend toward overassesment of their knowledge. Single factor analysis of variance showed that there are statistically significant differences in the distribution of average values of ratings opinions about confidence (JOLs) depending on the type of information [F (2,56) = 17,78; p = 0,000]. It means that the subjective belief of knowledge affects the way in which information is presented in the form of a text, statements or sentences. There are no statistically significant differences between the effects on subjective self-statements and text. D.J. Hacker, L. Ball and K. Bahbani [4] explain these results in a way that the high confidence in individuals' own knowledge affects the knowledge of the context information being stored in memory.

As noted by B.D. Pulford [6] people tend to underestimate their knowledge. Conversely, it was found out in our experiment that when remembering the statements studens subjectively designate information as easy and prove themselves excessively confident in their degree of assimilation. T.O. Nelson and L. Narens [5] suggest that using *gamma* correlation coefficient of Goodman-Kruskal (*G*) aims to establish the relationship between subjective assessments of probability and objective indicators of recollection. The specificity of the use of the indicator *G* is that it allows you to compare entire set of subjective assessments with multiple objective parameters of assessment and display indicator for each respondent separately.

Thus, we determined the following indicators that characterize the illusion of knowing as the indexes of confidence, calibration and resolution. Index of confidence is an estimation parameter of metacognitive judgments that states the nature of subjective evaluation with objective indicators of performance such as the effect of extreme overconfidence or underconfidence [2]. Index of calibration estimates metacognitive judgments stating the conformity assessment of subjective probability distribution on the proportion of correct answers in a particular category. The idea is that when the average confidence is 70%, the perfectly calibrated and considered response is also 70%. These calculations can be drawn by determining the index of calibration (*C*), as well as a graphical simulation of a calibration curve [4]. The index of resolution (or resolution index) estimates metacognitive judgments that state the variability of subjective ratings of probability distribution of proper feedback of all the categories. In order to determine how well individuals can discriminate their subjective assessments of right and wrong answers, regardless of the absolute level of confidence, such an assessment index is being often used (*R*). This criterion allows evaluating the uniformity of distribution of ratings of metacognitive judgments in relation to certain categories of probability. In other words, it determines whether a respondent gave similar responses and how sensitively and differently he or she can describe subjective evaluation of different sense equivalents.

The indicators influencing the illusion of knowing were calculated using single factor analysis of variance and LSD-analysis. The usage of a single factor analysis of variance statistically proved the dependence of the objectivity of metacognitive judgments on such characteristics as the type of information [F (2,56) = -0,19; p = 0,000].

Table 1. Mean values of the confidence index

The illusion of knowing factor	M (mean value)	SD (standard deviation)
Open-answer question (for texts)	-,034	0,66
Open-answer question (for statements)	-,017	0,6
Open-answer question (for word pairs)	,059	0,6
Questions with answers "yes" / "no" / "do not know" (for texts)	-,14	0,62
Questions with answers "yes" / "no" / "do not know" (for statements)	0,003	0,67
Questions with answers "yes" / "no" / "do not know" (for word pairs)	,006	0,66
Multiple-choice questions (for texts)	,036	0,66
Multiple-choice questions (for statements)	-,162	0,63
Multiple-choice questions (for word pairs)	0,063	0,7

With the help of LSD-analysis there were found statistically significant differences between mean values of indicators on confidence index factor "open-answer question for texts" (M = 0,07; SD = 0,17) and factor "multiple-choice questions for statements" (M = 0,27; SD = 0,74) effect on the occurrence of overconfidence or uncertainty [p = 0.002]. We also found statistically significant differences between mean values of indicators on confidence index factor "open-answer question for word pairs" (M = 0,14; SD = 0,13) and factor "multiple-choice questions for statements" (M = 0 27; SD = 0,74) effect on the occurrence of overconfidence or uncertainty [p = 0.006]. Statistically significant differences between mean values of indicators on confidence index factor "multiple-choice questions for statements" (M = 0,27; SD = 0,74) and "questions with answers "yes" / "no" / "do not know" for texts" factor (M = 0,1; SD = 0,14) effect [p = 0.002] occured. And what is more, there were seen statistically significant differences between mean values of indicators on confidence index factor "multiple-choice questions for statements" (M = 0,27; SD = 0,74) and a factor "questions with answers "yes" / "no" / "do not know" for texts" (M = 0,13; SD = 0,16) effect on the occurrence of overconfidence and uncertainty [p = 0.006].

Table 2. Mean values of the calibration index

The illusion of knowing factor	M (mean value)	SD (standard deviation)
Open-answer question (for texts)	0,07	0,16
Open-answer question (for statements)	0,15	0,15
Open-answer question (for word pairs)	0,13	0,13
Questions with answers "yes" / "no" / "do not know" (for texts)	0,09	0,13
Questions with answers "yes" / "no" / "do not know" (for statements)	0,14	0,13
Questions with answers "yes" / "no" / "do not know" (for word pairs)	0,12	0,16
Multiple-choice questions (for texts)	0,12	0,11
Multiple-choice questions (for statements)	0,26	0,74
Multiple-choice questions (for word pairs)	0,14	0,16

Table 3. Mean values of the resolution index

The illusion of knowing factor	M (mean value)	SD (standard deviation)
Open-answer question (for texts)	0,08	0,29
Open-answer question (for statements)	0,04	0,05
Open-answer question (for word pairs)	0,02	0,04
Questions with answers "yes" / "no" / "do not know" (for texts)	0,05	0,06
Questions with answers "yes" / "no" / "do not know" (for statements)	0,03	0,03
Questions with answers "yes" / "no" / "do not know" (for word pairs)	0,03	0,03
Multiple-choice questions (for texts)	0,04	0,04
Multiple-choice questions (for statements)	0,03	0,02
Multiple-choice questions (for word pairs)	0,03	0,03

With the help of a single factor analysys it was found out that the index of calibration strongly depends on such factors as type of text and information needed to understand and remember [F (2,56) = 108,6; p = 0.000].

As noted above, we used the index of resolution in order to establish how well individuals can distribute their subjective assessments of right or wrong answers, that is, how well thay are able to recognize the correctness or incorrectness of their own answers.

So, we revealed the following statistically significant differences of average values of the index factor resolution and factor "open-answer question for texts" (M = 0,08; SD = 0,297) and factor "open-answer question for texts statements" (M = 0,42; SD = 0,0,57) at the significance level of p = 0.21; of average values of the index factor resolution on "open-answer question for texts" (M = 0,08; SD = 0,297) and factor "questions with answers "yes" / "no" / "do not know" for word pairs" (M = 0,033; SD = 0,035) at the significance level of p = 0.034; of differences between mean values of the index factor resolution on "open-answer question for texts" (M = 0,08; SD = 0,297) and factor "multiple-choice questions for statements" (M = 0,03; SD = 0 29) at the significance level of p = 0.025; and also between the average index values factor resolution on "open-answer question for texts" (M = 0,08; SD = 0,297) and factor "multiple-choice questions for word pairs" (M = 0,32; SD = 0.31) at the significance level of p = 0.031.

Conclusions. As it can be seen, the ability of students to estimate the probability of correct reproduction depends on several factors. In particular, we can name the following factors that influence the value of the indexes: open-answer questions, questions with answers "yes" / "no" / "do not know", and multiple-choice questions for texts, statements and word pairs each. Using the index of resolution, for example, we have established a relationship between the student's ability to discriminate their subjective assessments of right and wrong answers regardless of the level of confidence. A clear tendency to reduce one common response when working with texts was traced. That is, in this case, students have the most accurate and sensitive judgments with respect to the assessment of their knowledge regardless of its correctness or incorrectness.

Thus, in the course of the experiment, we found that the occurrence of the illusion of knowing is most influenced by factors such as the type of test (e.g., excessive confidence in their knowledge leads to work on issues involving the questions with answers "yes" / "no" / "do not know"); type of information (for example, a number of students assess their knowledge when working with texts, and the illusion of knowing occurs while memorizing statements and texts); the amount of information (the illusion of knowing occurs when reading short texts); text style (students are the most confident in their knowledge in the case of reading texts of belles-lettres style).

Obviously, the impact of these factors in the learning activities should be minimized. Therefore, it is appropriate to develop some practical recommendations not only for students and teachers but also for other people who work with information in order to avoid the appearance of the illusion of knowing in the educational activities.

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