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Literature Review on Metacognition and its Measurement

Ahmet Oguz Akturk ^{a*}, Ismail Sahin ^b^a*Ermenek Community College, Karamanoglu Mehmetbey University, Karaman, 70400, Turkey*^b*Ahmet Kelesoglu Education Faculty, Selcuk University, Konya, 42090, Turkey*

Abstract

Metacognition is a structure that is referred as fuzzy by many scholars and has very diverse meanings. Much research has been conducted for more than 30 years in order to access the inner side of this structure, which is really hard to grasp. In this paper, the review of literature aims to reveal the theoretical and educational structure of the concept of metacognition chiefly on the basis of the relevant research. Then, an attempt will be made to determine the difference between cognition and metacognition. Finally, difficulties that are encountered in the measurement of metacognition and the methods and tools that will be used in the measurement of metacognition will be determined.

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1. Introduction

Metacognition is a structure that is referred as fuzzy by many scholars and has very diverse meanings. Much research has been conducted for more than 30 years in order to access the inner side of this structure, which is really hard to grasp. The roots of present metacognition studies are based on cognitive psychology (Hart, 1965; Peters 2007), on cognitive development psychology (Piaget, 1950; Steinbach 2008), and on social development psychology (Tsai 2001; Vygotsky, 1962). Hart (1965) was concerned with the correctness of the judgments that adults made about memory which reveals valid predictors of behaviour (Peters, 2007). Piaget (1950), on the other hand, was the one who first mentioned “knowing the knowing and thinking the thinking” in the early years of cognitive development and personal information epistemology (Steinbach, 2008). Vygotsky (1962) maintained that consciousness and conscious control were basic contributors during school years (Tsai, 2001).

According to Georgiades (2004), being aware of one’s cognition was already been mentioned by Plato. Likewise, Aristotle pointed out that mind used a different power above and beyond seeing and hearing and thus laid the foundations for thinking about metacognition long before (Sandí-Ureña, 2008). However, John Flavell (1976) is known to be the first scholar who used the concept of metacognition, a term he derived from the term metamemory and he used in his initial works in the early 1970s.

* Ahmet Oguz Akturk. Tel.: +90 338 716 5450; fax: +90 338 716 5452

E-mail address: aoakturk@kmu.edu.tr

2. Metacognition

Various words that are synonymous with metacognition have been in use in recent years. According to reports cited by Steinbach (2008), while some researchers use the word self-management for metacognition (O'Neil & Speilberger, 1979), others prefer the words metamentation (Bogdan, 2000) or meta-learning (Cross & Steanmand, 1996). Likewise, Veenman, Van Hout-Wolters and Afflerbach (2006) state some different terms used in the relevant literature in connection with metacognition such as metacognitive beliefs, executive skills, metacomponents and judgments of learning.

Today, metacognition is used as an umbrella term encompassing the structures that are related to individuals' thinking processes and information (Leader, 2008). Although various definitions are encountered in the relevant literature, probably the most common definition of metacognition is that metacognition is individuals' having information about their cognitive structure and being able to organize this structure (Flavell, 1979; Wellman, 1985; Brown, 1987; Jacobs and Paris, 1987; Schraw, 1994; Livingston, 1997; Dunlosky and Hertzog, 2000; Georghiades, 2004).

John Flavell (1976), who led studies regarding the concept of metacognition through his research, defining metacognition as follows: "metacognition refers to one's knowledge concerning one's own cognitive processes and products or anything related to them" (p.232). Flavell (1979) was concerned with investigating whether children were aware of understanding some components that govern their memories and cognitions. This research provided significant evidence about the fact that children possessed the ability to reflect their own cognitive processes. After this research, Flavell defined metacognition as information and cognition about the cognitive phenomenon and conceptualized it as the learner's information about his or her own cognition.

Brown (1978) conducted many studies after Flavell and focused on understanding information or the problems related to either effective use of information or understanding information for which a clear definition has been provided. He defined metacognition as students' awareness and organization of thinking processes that they use in planned learning and problem solving situations. Wellman (1985) defines metacognition as "thinking about thinking or a person's cognition about cognition" (p.1). Metacognition occurs as a result of one's individual evaluation and observation of their cognitive behavior in a learning environment (Ayersman, 1995). According to Baker and Brown (1980), metacognition is a theoretical structure where learners take effective responsibility of their learning and is individuals' being aware of their learning and its management.

Metacognition can be explained as individuals' information while they are learning or fulfilling a task and a deliberate organization in cognitive processes (Brown, Bransford, Ferrara & Campione, 1983; Miller, 1985). Swanson (1990) defines metacognition as individuals' awareness of their ability to monitor, regulate and control their own activities concerning learning. Metacognition generally means higher level thinking about how a learning task will be handled, and making plans on processes of observing and evaluating comprehension (Livingston, 1997). Wilson (1998) regards metacognition as knowledge and awareness of thinking processes and strategies (together with the ability to evaluate and organize these processes). Scarr and Zanden (1984), on the other hand, define metacognition as individuals' awareness and comprehension of processes of regulating their mental state, skills, memory and behavior.

Although there are many different definitions concerning metacognition, the one common point is to monitor strategies for the learning process (Bonner, 1988) and many other researchers blend two different approaches that emphasize the importance of cognitive states and processes and the control of the executable aspect of metacognition in a single definition (Paris & Winogard, 1990). This definition involves individuals' planning of their information about their own and others' cognitive processes before they fulfill their task, observing their thinking, learning and understanding while performing a task, controlling and regulating their thinking by making arrangements on site and evaluating after they have completed their task (Scott, 2008).

3. Difference between Cognition and Metacognition

It will be useful to reveal the difference between cognition and metacognition while explaining the concept of metacognition. The concepts of cognition and metacognition are different although they are related to each other. While metacognition is necessary to understand how a task will be performed, cognition is required to fulfill a task (Schraw, 2001). While cognition means being aware of and understanding something, metacognition is being aware of and knowing how one learns in addition to learning and understanding something (Senemoğlu, 2005). According to Gourgey (1998), on the other hand, cognition is necessary to form the learning process and information while metacognition is required for individuals to observe, develop, and evaluate their own processes and apply their knowledge to new situations. Therefore, metacognition is a basic requirement for cognitive effectiveness.

It is necessary to understand the relationship between metacognition and cognition. Metacognitive activities occur before cognitive activities (planning), during activities (monitoring) or after activities (evaluating). We can give as an example a student who uses self-observation strategy during reading to exemplify the relationship between metacognition and cognition. The student knows that s/he can not comprehend (metacognition) what s/he is reading. At the same time, s/he knows that s/he can understand the text better when s/he prepares a conceptual map or makes a summary (cognition). This relationship is shown in Figure 1. (Wahl, 2007; cited by Altındağ, 2008).

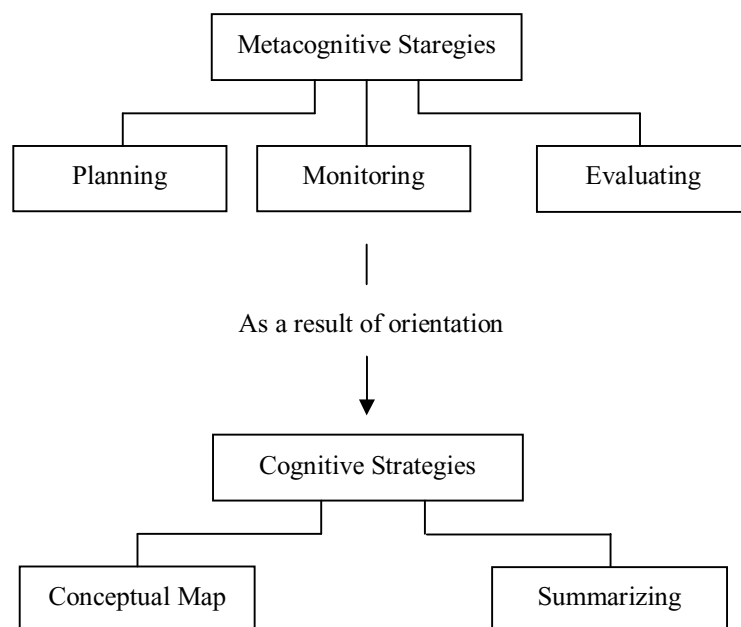


Figure 1. Relationship between cognition and metacognition

4. Measurement of Metacognition

As stated by Peters (2007), existence of metacognition was first investigated by Hart (1965), Underwood (1966) and Arbuckle and Cuddy (1969) in the 1960s. In his study, Hart (1965) asked participants questions that involved general information. Then, he asked them what they thought about the solution to the problem for each question. He concluded that the participants' ideas about the solution to the problem were definite predictors of the correct answers to the questions. Underwood (1966), on the other hand, asked the participants about their views concerning the difficulty of each item on the test and demonstrated that the ideas of each individual could predict their own

learning. Arbuckle and Cuddy (1969) worked on individual judgments about learning and concluded that individuals' judgments on their own learning were highly accurate.

Measurement of metacognition is naturally difficult because metacognition is not an explicit behavior. Metacognition is not internal process only; on the contrary, individuals are not aware of these processes. As cited by Sandí-Ureña (2008) from Veenman (2005), he defined methods of measuring metacognition, via the temporary relationships of the method of measurement concerning the implementation of a task, as probable if it was implemented before the task, simultaneous if it was implemented during the task and retrospective if it was implemented after the task. Measurement tools that are used to measure metacognition can be investigated in two categories, namely reports based on an individual's own telling (questionnaires and interviews) and objective behavior measurements (i.e. systemic observation and think aloud protocols). The method of measuring metacognition, on the other hand, can be determined according to the type of the measurement tool that was used to measure metacognition.

Simultaneous (synchronic) measurement of metacognition is implemented using tools that cause considerable loss of time and require that participants be evaluated individually. Tools that are most frequently used in the simultaneous measurement of metacognition are "think aloud protocols and systematic observations" (D. Rickey, 1999; Veenman, 2005; cited by Sandí-Ureña, 2008). Think aloud protocols allow the researcher to determine students' metacognitive ideas "online". Thus, students tell you verbally how they handle a certain problem. There are two problems in this type of measurement. One of those is that think aloud protocols may prevent students from learning the present materials while they express their metacognitive opinions verbally. The second is that while think aloud protocols are useful in the laboratory conditions, they are not functional in the classroom environment because when students are asked to think aloud while they are performing a task, it is necessary that they leave their typical learning environment. If the point of interest is how students learn in a classroom environment and how they use metacognitive thinking, think aloud protocols are not appropriate (Scott, 2008). Although systematic observations are useful in determining students' non-verbal metacognitive behavior diachronically, it also involves some disadvantages such as implementation with a small number of students and difficulty of student control. The tools that are most commonly used in probable and retrospective evaluation of metacognition are questionnaires and interviews.

The questionnaire is one of the most frequently used tools for measuring metacognition. However, it has both positive and negative aspects. The basic drawbacks of a questionnaire based on an individual's own report are the possibility that the students may be reluctant to express their ideas and experiences, the possibility that the questionnaires may not have been understood fully by all of the students, and the possibility that the questions might stimulate socially attractive questions (Baker & Cerro, 2000; cited by Scott, 2008). However, the positive aspects of questionnaires outweigh their negative aspects in terms of certain research questions. First, questionnaires enable researchers to evaluate larger student groups in one go without interfering with their classroom experiences. Questionnaires can be easily administered to groups and evaluated quickly and objectively (Tobias & Everson, 1996). Second, in contrast to interviews, questionnaires attain equality for all students in the collection of data that vary from student to student depending on the students' initial reactions. Finally, questionnaires can be used reliably and effectively in some structures where it is not possible to observe motivation and cognitive engagement (Pintrich & DeGroot, 1990).

Interviews are useful in that they enable an in-depth investigation of students' ideas. Interviews have the power to demand the students to expand on the answers that they have given if they have responded to the interview questions in the form of "yes" and "no". The basic problem concerned with using interviews in measuring metacognition is that it causes loss of time due to the fact that the method requires a mutual and interactive communication process based on asking and answering questions and that it can not be implemented in a classroom environment (Scott, 2008).

5. Conclusion

To sum up, it can be said that teaching students how to use metacognitive strategies increases academic achievement (Biggs, 1988). Students with advanced metacognitive skills are those who are aware of what they have learned and what they do not know. Generally, students with advanced metacognitive skills may monitor their own learning, express their opinions about the information, update their knowledge and develop and implement new learning strategies to learn more. In comparison to other students, students using their metacognitive skills effectively are those who are more aware of their strengths and weaknesses and strive to improve their learning skills further (Bransford, Brown & Cocking, 1999). According to Jones, Farquhar and Surry (1995), the further students' awareness of metacognition is improved, the more students' effectiveness is increased.

Despite to efforts aimed at increasing awareness, teaching and use of metacognition, studies concerning evaluation of metacognition are not parallel to the interest shown in metacognition. A lack of appropriate evaluation has been stated as an obstacle to the improvement of researches. Currently, the need for tools to measure metacognition continues. Schraw (2009) points out the difficulty of measuring metacognition and states that a single method that enables simultaneous connection to metacognition processes and allows for measurement of all of these processes alone does not exist. Tobias and Everson (2002) emphasize this point and state that metacognition is measured on the basis of observations, dialogues and individuals' self-reports. In conclusion, there is no single tool that can measure metacognition alone.

Note

The present study has been compiled from the first author's doctoral dissertation entitled "Effects of Metacognitive Instructional Strategies in Computer Course", which was completed in Program of Curriculum and Instruction, Department of Educational Sciences at Graduate School of Educational Sciences, Selcuk University.

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