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Effects of Some Students-Related Factors on Their Metacognitive Awareness

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Abstract

The impact of some students' related factors on their metacognitive awareness was examined in the present study. 1800 students of grade X participated in the study. The sample was selected from 120 secondary schools. Metacognitive awareness was measured using metacognitive inventory.

Results indicated that metacognitive awareness was significantly correlated with internet use and library habits. It was found that children of highly educated parents were highly metacognitively aware than the children of less educated parents. Results further indicated that there was no significant difference in the metacognitive awareness of male and female students.

Key words: Metacognition; metacognitive awareness; cognitive processes

Introduction

An early definition of metacognition by Flavell (1976) has become regularly quoted in the literature. He referred metacognition as "One's knowledge concerning one's own cognitive processes and products or anything related to them...Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of theses processes in relation to the cognitive objects or data on which they bear..." (p. 232). Later Flavell (1979) expanded the term "metacognition" and the concept to include the (i) metacognitive knowledge and (ii) regulation of cognition.

After Flavell, the concept of metacognition was expanded by Brown (1980). He furnished a broad definition. "Metacognition refers to one's knowledge concerning one own cognitive processes…

> Metacognition refers, among other things, to the active monitoring and consequent regulation and orchestration of these processes in relation to the cognitive objects or data on which they bear, usually in the service of some concrete goal or objective"(p.32).

Following the Flavell concept of metacognition, researchers started to explore different forms of monitoring, regulation and orchestration. After Flavell, the concept of metacognition was expanded by Brown (1980). Similarly, Schraw & Moshman (1995) divided metacognition into metacognitive knowledge and metacognitive control processes (regulation of cognition). They argued that metacognitive knowledge is not necessarily stable but children routinely use metacognitive knowledge without being able to express that knowledge. They also classified metacognitive regulation into three skills as planning, monitoring and evaluation.

(i) Planning involves the selection of strategies and the allocation of resources.
(ii) Monitoring refers to awareness of comprehension and task performance.
(iii) Evaluation refers to value judgment.

Metacognition has been defined in many ways and encompasses various dimensions. That is why metacognition has been considered as a fuzzy concept (Flavell, 1981, p37; Wellmann (1981, as cited by Brown, 1987, p. 106)) as it is related to different disciplines (cognitive psychology, developmental psychology, philosophy of mind), and thus has been examined for various purposes from various standpoints. These viewpoints are discussed in below paragraphs:

Hudgins, Phye, Schau, Theisen & Ames (1983, pp. 68-73) described that metacognition is a cognitive skill which involves not only memory monitoring but also the monitoring of comprehension, problem solving and other cognitive skills as shown below:

Cognitive academic tasks	Cognitive skills	Cognitive processes
Language development Reading Mathematics Writing	Thinking skills Comprehension skills Study skills Remembering skills Transfer skills Inferential skills Problem solving skills Critical thinking skills Creative thinking skills	Attention Recognition memory Memory storage Memory retrieval Metacognitive processing

Table 1 Task, Skills and Processes

Howard, McGee, Shia & Hong (2000) found that metacognitive awareness and regulatory skills comprised of five independent factors: knowledge of cognition, objectivity, problem representation, sub-task monitoring and evaluation.

Kuhn, Amsel, & O'Loughlin (1988) noted that main aspect of metacognitive operations involve "*conscious awareness*": the ability to think about a theory rather than only with it (p. 219). In other words, people are metacognitive when they make their own thoughts "*objects of cognition*" (Kuhn, *et al*., 1988). Baird, Fensham, Gunstone, & White (1991) have described metacognition as,

> A person's knowledge of the nature of learning, effective learning strategies, and his/her own learning strengths and weaknesses; awareness of the nature and progress of the current learning task (i.e. what you are doing and why you are doing it); and control over learning through informed and purposeful decisions making (p. 164).

Blakey and Spence (1990) consider metacognition as a three-step process:

(1) Connecting new information to previous knowledge
(2) Deliberately selecting thinking strategies
(3) Planning, monitoring, and evaluating the thinking processes

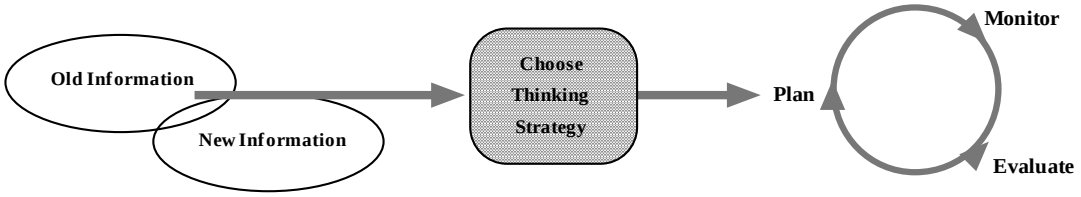

Figure 1 Three steps in Metacognition (Source: Blakey and Spence, 1990)

Although metacognition has been a part of discussion of educational psychologists for more than twenty years, but a clear definition of metacognition, is still not agreed upon. However, researchers agreed to divide it into two constructs: metacognitive knowledge and metacognitive control and regulation (figure-2)

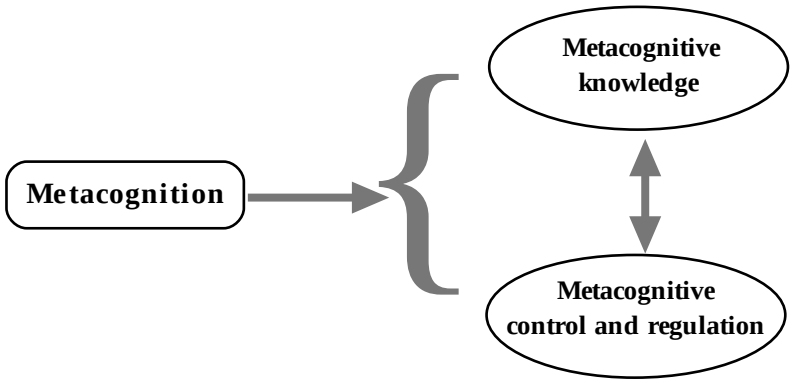

Figure 2 Metacognition: the two constructs

From the above discussion it may be concluded that in defining metacognition, there were three major obstacles which included: conceptualizing the main aspects of metacognition, establishing the relationship between these aspects, and distinguishing between cognition and metacognition (Wilson & Clarke, 2002).

The above cursory review of literature illustrates the multidimensional character of the term metacognition. Metacognition is therefore characterized as:

(1) An awareness of one's own thinking;
(2) An awareness of the content of one's conceptions;
(3) An active monitoring of one's cognitive processes;
(4) An attempt to regulate one's cognitive processes in relationship to further learning; and
(5) An application of a set of heuristics for helping people to organize their methods of solving problems.

Metacognition is an important concept both for teachers and students to evaluate their background knowledge related to the topic under consideration. It enables them to identify what is new knowledge and establish a connection between new and previous knowledge.

Research on Metacognition

Research on metacognition sought to answer questions, such as:

(i) How does metacognition develop?
(ii) Can metacognitive teaching make a difference?
(iii) Does metacognitive teaching lead to better regulation of one's cognitive activities?

Metacognition & Learning

Metacognition is a predictor of learning. It makes students to work independently and flexibly. The high level of awareness that distinguishes metacognition is associated with a desire for self-knowledge, whereas low self-consciousness results in intellectual defensiveness (Luca & McMahon 2004).

Reid (2005) stated that the role of metacognition in learning is of great importance as it is related to the learner's awareness of thinking and learning. Tunmer and Chapman (1996) have shown how dyslexic children have poor metacognitive awareness that leads to inappropriate learning behaviours in reading and spelling.

Kim (2005) examined the effects of a reflective thinking tool on learners' performance and metacognitive awareness in the context of on-line learning. Findings of the study showed that students' metacognitive awareness was significantly increased by the activity of reflective thinking. Results also indicated that students having a higher level of reflective thinking show a higher regulation of cognition.

Various studies have revealed that learning can be enhanced if students use metacognitive processes, i.e.; they are aware of, monitor and control their own learning (Baird, 1998; Hacker, 1998; White & Gunstone, 1989 as cited by Conner, 2006). Good learners are metacognitively adept and poor ones metacognitively deficient in how they tackle learning tasks in most subjects (Baird, 1986, 1992, 1998; Shuell, 1998; Wang & Peverly, 1986 as cited by Conner, 2006).

Conner (2006) reported that probably all learners are metacognitive to some extent. The degree of awareness of metacognitive processing influences the extent to which individuals preferentially use strategies. Students spontaneously interpret tasks according to what they think the task demands. It means that most students apply their knowledge

or strategies as best they can. He also reported that those students who were aware of and used strategies to plan, monitor and evaluate their work created high class essays. Corliss (2005) investigated the effects of reflective prompts and collaborative learning on problem solving and metacognitive skills in hypermedia problem based situation. He concluded that collaborative learning combined with reflective prompting did not benefit students on the near transfer task and the metacognitive awareness inventory (MAI) score.

Adesope, Leacock, Nesbit and Winne (2005) found that scaffolds influence learning and other computer based metacognitive activities. Baadth and Dutke (2005) found a significant relationship between metacognitive control processes and executive functioning. Thus individual having poorer central executive switching abilities have less metacognitive control in updating social mental models. The result of the study by Webster (2005) indicated that the ability of each individual to develop a personal learning resource and reflect on the role of metacognitive characteristics could be a useful instrument in the development of the independent lifelong learner.

Mittlefehdt & Grotzer (2003, p.19) concluded that metacognition plays an important role in the transfer of casual models between topics in science. They also supported that during learning within group contexts, students are more likely to test the limitations of their ideas by using a broader range of metacognitive strategies than they tend to use when they individually reflect on their thinking.

This also indicates that presenting new ideas to students, it is helpful to use more than one metacognitive strategy to involve students in reflective thinking. They further support the idea that connecting new ideas to previous knowledge helps students understand learning objectives and the student can effectively compare their ideas to other students. Similarly, Davidowitz & Rollnick (2003) investigated the growth of metacognition by giving an insight into four university chemistry students with the introduction of competency tripod model and flow diagrams. The students were found to engage in metacognitive practices as a result of that intervention.

Dori and Saar, (2004) investigated the effectiveness of a self-developed metacognitive tool for high school chemistry students' comprehension of adapted scientific articles. In this study 300 chemistry students were asked to assess the quality of the questions according to three dimensions classification taxonomy, which characterize "complex and deep question" by reading five scientific articles and responding to two types of pre- and a post-questionnaire. The students were divided into experimental and control groups. Students in the experimental group used the metacognitive tool; while students in the control groups only read the articles and responded to the questionnaires. It was found that the metacognitive tool was effective in raising students' declarative metacognitive knowledge and their awareness to the way they regulate scientific text comprehension, indicating that this tool should be further explored.

It may be concluded that highly metacognitive people have the ability to think about their thinking. Such people can stand outside themselves and evaluate and monitor their thinking. Also the learners who frequently use their metacognitive abilities are aware of their thinking. Thus metacognition improves learning. Research literature also mentioned same effects of metacognition on reading ability of students as indicated below:

Metacognition and Reading

Role of metacognition in reading is an important contribution of cognitive psychologists. Research on metacognition has identified self-regulatory processes that improve achievement and instructional practices in reading comprehension.

Metacognitive readers know both their own learning characteristics and the task demand. They are able to select, apply, monitor, and evaluate strategies, and are able to recognize and mend comprehension failures (Schraw & Moshman, 1995).

Myers and Paris (1978) focusing on metacognative knowledge about reading processes found that younger children showed lack of knowledge about critical reading parameters as compared to older children.

Collins (1994) reported that relation between metacognitive knowledge and reading comprehension was investigated in 13 studies. In most studies, metacognitive knowledge (knowledge of task demands) was correlated with reading variables (e.g. strategies, prior knowledge) and reading comprehension. Metacognitive knowledge and reading comprehension were related significantly in 92% (n = 12) of the studies. Significant findings were reported in 10 experimental studies (Chan, et al., 1987; Idol; Idol & Croll; Wong & Jones, cited in Billingsley & Wildman, 1990; Pressley, cited in Harris & Pressley, 1991; Rottman & Cross, 1990; Schunk & Rice, 1992 Studies 1 & 2; Schunk & Rice; Weisberg & Balajthy, cited in Weisberg, 1988; Simmonds, 1990), 1 quasi-experimental study (Wong & Wong, 1986), and 1 non-experimental study (Taylor, cited in Paris, et al., 1991).

Cross-and Paris (1988) reported significant increase between the third and fifth grades with respect to knowledge about cognition and regulation of cognition during reading. Knowledge of cognition was measured using a 15-question reading awareness interview and a strategy-rating task while regulation of cognition was measured by comparing pre and posttest measures of error detection proficiency and changes in reading comprehension. Unlike the treatment group, significant changes did not occur among control subjects. Similar results reported by Kurtz and Borkowski (1987) and Palincsar and Brown (1984) as cited by Schraw & Moshman, 1995.

It is concluded from the findings of the above research studies that metacognition is positively correlated with reading comprehension. As metacognition enables a student to think about, plan, and monitor performance on an educational task; it therefore, provides students motivation for learning. Metacognition is the knowledge of one's own thinking processes and strategies and it affects academic achievement /success of learners.

Objectives of the Study

The main objectives of the study were to:

- Measure metacognitive awareness of students
- Assess impact of some students' related factors on their MAI
- Measure gender differences in MAI among students

Research Hypotheses

For literature review a number of research journals have been studied which lead to the formulation of the following hypotheses:

1 There is a significant difference between Metacognitive awareness of male and female students.
   H_o: There is no difference between metacognitive awareness of male and female students.

2 There is a significant difference between mean score of children of highly educated and less educated mothers' on metacognitive inventory.
   H_o: There is no difference between mean score of children of highly educated and less educated mothers' on metacognitive inventory.

3 There is a significant difference between Metacognitive awareness of urban and rural students.
   H_o: There is no difference between metacognitive awareness of urban and rural students.

Methodology

This was a survey study. Metacognitive awareness of students was assessed using metacognitive inventory (MAI). The impact of following student related factors were taken into account

Mother Education
Parent guidance
Tution availability
Use of Internet
TV watching

Library habit
Locality
Gender

Information about the above factors was collected along with the metacognitive inventory.

Research Instrument

For assessing student metacognitive awareness a review of empirical studies and standardized instruments was carried out so that a culturally suitable and valid and reliable inventory may be adapted. After an extensive literature review the researcher adapted Schraw and Dennison, 1994 metacognitive awareness inventory (MAI) because it is a reliable and valid instrument available. The inventory represents two component categories of metacognition, knowledge of cognition and regulation of cognition. The knowledge component included the declarative, procedural and conditional knowledge while the regulation component included the planning, management strategies and evaluation. The inventory was a five point Likert scale ranging from "Always" to "Not at all" in which the participants were asked to tick appropriate box. The responses were coded as:

Always = 5	Frequently = 4	
Sometimes = 3	Undecided = 2	Not at all = 1

In order to measure validity and reliability of the inventory a pilot test was conducted. Before administration of the instrument, the students were informed about the objectives and application procedure of the instrument. The respondents were asked to read the statements carefully and indicate their response by tick marking the appropriate box. They were told that there are no right and wrong answers to the statement in the inventory. They were further asked to rate themselves on use of metacognition as accurately and honestly as they could. Average completion time for the inventory was ten minutes.

Participants

For this study a random sample of 1800 students of grade X enrolled in science group was selected. The sample consisted of 900 urban students (525 male and 375 female) and 900 rural students (525 male and 375 female). The sample was chosen from 120 secondary schools. From each school a group of 15 students was selected randomly.

Data Analysis

Mean and standard derivation was performed for assessing the metacognitive awareness of science students. Multivariate analysis of variance and independent sample test were used for testing the hypotheses of mean differences of male Vs female science students. Hypotheses were tested at alpha .05 level. SPSS version 13.0 for windows was used for the analysis of data.

It is possible to consider several variables and see whether they relate to the metacognitive awareness of the students. The variables are: mother education, parent guidance, tuition availability, use of Internet, library book reading, locality and gender. The data analysis is discussed in tables below.

Table 2 MAI Mean Score of Students by Gender

MAI Sub Scales	**Male students**		**Female students**		***Statistics***	
N = 1800	***M***	***SD***	***M***	***SD***	***t-test***	***P***
Procedural knowledge	16.0	2.5	15.7	2.3	2.6	$p < 0.01$
Declarative knowledge	24.6	3.1	23.9	3.1	5.1	$p < 0.001$
Conditional knowledge	16.7	2.3	16.8	2.4	-0.6	n.s.
Planning	21.1	2.8	20.6	3.1	3.3	$p < 0.001$
Management strategies	40.7	4.9	43.3	4.9	-10.8	$p < 0.001$
Evaluation	28.2	3.9	27.4	4.3	4.1	$p < 0.001$

Table 2 discloses a comparison of male and female students for different sub scales of the inventory. Table reveals that male students possessed high mean score on declarative knowledge, and evaluation while female students have high average score on management strategies. However, the differences, although highly significant, are very small.

Table 3 Students' Mean Score on different Components of MAI

		Knowledge of Cognition			**Regulation of Cognition**			**MAI Score**		
	N	***M***	***SD***	***t-test***	***M***	***SD***	***t-test***	***M***	***SD***	***t-test***
Urban	900	58.4	5.8	T = 11.2	91.6	8.7	t = 4.9	150.0	12.4	t = 8.4
Rural	900	55.3	6.0	P < 0.001	89.5	9.8	p < 0.001	144.8	13.9	p < 0.001

Table 3 presents a picture of MAI mean score of students of urban and rural localities. In every case, the urban students perform better.

Table 4 Students Mean Scores on Different Components by Gender

		Knowledge of Cognition			Regulation of Cognition			MAI Score		
	N	***M***	***SD***	***t-test***	***M***	***SD***	***t-test***	***M***	***SD***	***t-test***
Male	1050	57.3	6.2	t = 3.4	90.0	8.8	t = -2.8	147.3	13.0	t = -0.4
Female	750	56.3	5.9	p < 0.001	91.3	9.9	p < 0.01	147.6	14.1	n.s.

It is revealed from table 4 that male students have higher mean score than female on knowledge of cognition while the female students performed better on the regulation of cognition.

Table 5 Mother Education Vs Student MAI

N = 1800	**Option**	**Frequency**	**%**	**Student MAI Score (Mean)**
Mother's Education	Illiterate	1210	67	147
	Primary	323	18	148
	Middle	21	1	151
	Matric	151	8	150
	Inter	34	2	150
	Bachelor	61	6	152

It is possible to correlate the mother's education level with the student MAI score (r = 0.07, p < 0.01) and test score (r = -0.03, n.s.) using Kendall's Tau-b. This means that students tend very, very slightly to be more self aware in terms of metacognition if their mothers are better educated.

Table 6 Parental Guidance related to MAI

Variable	**Option**	**Frequency**	**%**	**Student MAI Score (Mean)**
Parents'	*Not at all*	319	18	147

Guidance				
	Sometimes	512	28	146
	Always	969	54	149

It is possible to correlate the student perceived level of parental guidance with the student MAI score (r = 0.03, n.s.) using Kendall's Tau-b. This means that the student perceived level of parental guidance is not related to metacognitive awareness.

Table 7 Tuition Availability & MAI

Variable	Option	Frequency	%	Student MAI Score (Mean)
Tuition	*Not at all*	783	44	148
	Sometimes	561	31	145
	Always	456	25	149

It is possible to correlate tuition availability with the student MAI score (r = 0.03, n.s.) using Kendall's Tau-b. This means that tuition availability was not related to metacognition.

Table 8 Internet Use & MAI score of Students

Variable	Option	Frequency	%	Student MAI Score (Mean)
Internet use	*Not at all*	826	46	146
	Sometimes	466	26	148
	Always	508	28	149

It is reported in table 7 that internet use can be correlated with MAI of students (r = 0.06, p< 0.002) by using Kendall's Tau-b. It is highly likely that those with access to the internet and an interest in using it will be those who are more metacognitively aware.

Table 9 TV watching & Metacognitive Awareness scores

Variable	Option	Frequency	%	Student MAI Score (Mean)
TV watching	*Not at all*	151	8	147
	Sometimes	796	44	147

	Always	853	47	148

It is reported in table 8 that TV watching can be correlated with MAI of students ($r = 0.05$, $p < 0.005$) by using Kendall's Tau-b.

Table 10 Library Use & MAI score of Students

Variable	Option	Frequency	%	Student MAI Score (Mean)
Library use	*Not at all*	893	50	146
	Sometimes	641	35	148
	Always	266	15	150

It is reported in table 10 that library use can be correlated with MAI of students ($r = 0.07$, $p < 0.001$) by using Kendall's Tau-b.

Table 11 Testing of Research Hypotheses

Hypothesis	Statistics	p	Results
Hypothesis 4: There is a significant difference between Metacognitive awareness of male and female science students. H_0: There is no difference between metacognitive awareness of male and female science students. H_1: The average score of the male science students on metacognitive inventory is higher than average of female students on MAI. H_2: The average score of the female science students on metacognitive inventory is higher than male students.	t = -0.40	n.s.	Null hypothesis accepted, there was no significant difference between MAI score of male and female students,
Hypothesis 5: There is a significant difference between Metacognitive awareness of urban and rural science students. H_0: Average score of metacognitive	t = 8.41	< 0.001	The scores in the MAI test of urban students are very much higher than the scores of rural

awareness of urban science students is higher than rural students. H_1: Average score of metacognitive awareness of urban science students is higher than rural students. H_2: Average score of metacognitive awareness of rural science students is higher than urban students.			students

The urban students are clearly showing behavior characteristics related to learning which is much more positive than those of the rural students. This probably reflects the different paces of educational development in urban and rural areas. There is also a strong tendency for those who perform better to be those who are more educational aware.

Table 12 Regression Analysis Results for variables predicting Students' MAI Score

Model	Variables	R^2	B	SE B	β	t	Sig
1.	Mothers' Edu	.161	.297	.087	.290	3.403	.001

Table 12 shows that an another regression analysis was also performed using students' MAI score as dependent variable and parents' qualification, parents' guidance, tuition, use of internet, TV watching, library books reading, gender, and locality as independent variables. Independent variables were correlated to test that a correlation existed between dependent and independent variables. Results indicated that mother's education was significantly accounted for difference in MAI score of students, β= .29, at p=0.001. The results further show that all other variables did not significantly account for students' metacognitive

Findings and Discussion

The results of the study indicated that there was no significant difference between metacognition of male and female science students. Thus the present study did not found any significant gender differences in metacognitive awareness. The results also provided a mean of support to previous researches on relationship of metacognition and students related factors. The results of the study indicated that mothers' education and parents' guidance might play an important role in metacognition of students. One of the research hypothesis of the study was that there is a significant correlation between metacognitive awareness and mother education of students. The statistical analysis indicated that the children of highly educated mothers were highly metacognitively aware.

Another important finding of the present study was that there is a significant correlation between computer use and metacognition which is in line with the findings of past researches. The results of the study also revealed that students with library habits performed better on the inventory than other students. One of interesting findings of the study was that students who always watched TV were highly metacognitively aware.

This study also has some limitations, which may require attention in future research. Firstly, the sample of the present study consisted of science students of grade X. So the inventory may be applied to students of different subjects at different level.

Secondly, that metacognitive awareness of students was assessed with the help of inventory. The inventory used is self-report assessment tool, and for a broader perspective different assessment measures may be taken in future research. Furthermore, the inventory may be subjected to factor analysis for revalidation. However, as a first step the present study provides significant information about the concept and assessment of metacognition.

Recommendations

1. Computer may also be introduced as compulsory subject for students from the beginning as it has also linked with metacognitive awareness of students.
2. Mothers' education may be given due attention as it plays a positive role in the metacognition of children.
3. Proper attention may be given to develop library habits in students as it has a positive impact on the metacognitive awareness of students.
4. This was a co-relational study based on quantitative data. The study was delimited to secondary school science students and subject of chemistry therefore a study may be conducted on other subjects and level.

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References

Adesope, O.O; Leacock, T; Nesbit, J.C; & winne, P.H. (2005). Using Software Tools to Promote Metacognition. The Learning Kit Project. Canada: Research study conducted by Simon Fraser University.

Baadte, C; & Dutke, S. (2005). *Updating social mental models: Towards the role of metacognitive control skills.* (Master's thesis, University of Kaiserslautern). Germany.

Baird, J. R., Fensham, P. J., Gunstone, R. F., & White, R.T. (1991). *The importance of reflection in improving science teaching and learning. Journal of Research in Science Teaching,* 28(2), 163-182.

Brown, A. (1987). *Metacognition, executive control, self regulation and other more mysterious mechanisms.* In F. weinert & R. Kluwe (Eds) Metacogniton, Motivation and Understanding. Hillsdale, NY: Erlbaum.

Collins, N. (1994). *Metacognition and reading to learn*. ERIC Digest No ED376427. Retrieved on September 24, 2006, from http://128.104.40.21//step/kw/TheoreticalPerspectives/CognitiveTheory/Metacognition

Conner, L.N. (2006). *Cueing metacognition to improve researching and essay writing in a final year high school biology class. Research In Science Education.* Retrieved on January 15,2007, from http://www.ir.centerbury.ac.nz

Corliss, S. B. (2005). *The effects of reflective prompts and collaborative learning in hypermedia problem based learning environments on problem solving and metacognitive skills.* (Unpublished Doctoral dissertation, University of Tezas). Austin:

Cross, D. R; & Paris, S. G.(1988). *Developmental and instructional analyses of children's metacognition and reading comprehension*. *Journal of Education Psychology,80:* pp.131-142.

Davidowitz, B; & Rollnick, M. (2003). Enabling Metacognition in the Laboratory: A Case Study of Four Second Year University Chemistry Students. Research in Science Education, 33,pp 43-69.Netherland: Kluwer Academic Publishers.

Dori, Y.J & Saar, L. (2004). *A metacognitive tool for chemistry student's comprehension of adapted scientific articles.* A research study conducted at Isreal Institute of

Technology.Isreal: Retrieved from http://www.educ.com.ac.uk/download/MetacogAbstr.pdf

Flavell, J. H. (1976). Metacognitive Aspects of Problem Solving. In L.B. Resnick (Eds). The Nature of Intelligence. New York: Erlbaum.

Flavell, J. H. (2004). Theory-of-Mind Development: Retrospect and Prospect. Merrill-Palmer Quarterly, July 2004, Vol. 50, No. 3, pp. 274–290.

Flavell, J. H.(1987). Assumptions On The Concept Metacognition and on The Development of Metacognition. In F. weinert & R. Kluwe (Eds) Metacogniton,Motivation and Understanding. Hillsdale,NY: Erlbaum.

Howard, B. C; Mc Gee, S; Shia, R & Hong, N. S.(April 2000). *Metacognitive self regulation and problem solving: Expanding the theory base through factor analysis.* Paper presented at the annual meeting of the American Research Association, New Orleans; LA:

Hudgins, B. B; Phye, G. D; Schau, C. G; Theisen,G.L; Ames, C; & Ames, R. (1983). *Educational psychology*. Illinois: F.E. Peacock.

Kim, Y. (2005). *Cultivating reflective thinking: the effects of a reflective thinking tool on learners'learning performance and metacognitive awareness in the context of on-line learning.* (Unpublished Doctoral thesis, College of education, University of Pennsylvania).Pennsylvania:

Kuhn, D., Amsel, E., & O'Loughlin, M. (1988). *The development of scientific thinking skills.* San Diego, CA: Academic Press.

Luca, J. & McMahon, M. (2004). *Promoting metacognition through negotiated assessment.* In R. Atkinson, C. McBeath, D. Jonas-Dwyer & R. Phillips (Eds), Beyond the Comfort Zone: Proceedings of the 21st ASCILITE Conference (pp. 562-570). Perth, 5-8 December,2004.

Mittlefehldt, A; & Grotzer, T. (2003). *Using metacognition to facilitate the transfer of causal models in learning density and pressure*. A paper presented at the National Association of Research in Science Teaching Conference held on March 23-26,2003 at Philadelphia,PA:

Paris, S. G., & Winograd, P. (1990). *How metacognition can promote academic learning and instruction.* In B. F. Jones & L. Idol (Eds.), Dimensions Of Thinking And Cognitive Instruction (pp. 15-51). Hillsdale, NJ: Erlbaum.

Reid, G. (2005). *Dyslexia, metacognition and learning styles.* University of Edinburgh, Scotland. Retrieved on August 21,2006 from http://www.gavinreid.co.uk.

Schraw, G., & Moshman, D. (1995). *Metacognitive theories. Educational Psychology Review, 7,No 4,*pp351-371.

Schraw, G; & Dennison, R. (1994). *Assessing metacognitive awareness. Contemporary Educational Psychology.19(4)*(pp460-475)

Webster, R. (2005). *Metacognition and the autonomous learner: Student reflections on cognitive profiles and learning environment development.* Edith Cowan University. Perth: A digital research paper available at http://www.webster.edu.a

Wilson, J; & Clarke, D. (2002). *Monitoring mathematical metacognition.* A paper presented at the annual meeting of the American Educational Research Association, New Orleans,LA, April 1-5,2002.

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