Chapter Two

Literature Review

2.1 Metacognition

2.1.1 The history of metacognition

Before the word metacognition was coined, developmentalists such as Dewey and Piaget acknowledged that children learn by doing and by thinking about what they are doing in their studies about mental processes (Kirkpatrick, 1985:10). When Pólya (1957) developed his heuristics for problem solving, he was outlining ways for students to reflect on their progress and to assess the successfulness of the procedures used. He was providing "metacognitive prompts" for awareness of knowledge about problem solving and monitoring of work completed (Lester, 1985:10). Vygotsky's theory of internalization and zone of proximal development, described in *Mind in Society*, is closely related to the regulation part of metacognition (Schoenfeld, 1987, 1992:334-370). In addition, according to Silver (1985), many researchers have been interested in metacognitive skills but labeled them as "control processes" "reflective intelligence," and "executive scheme", etc.

Another predecessor to metacognitive studies was Thorndike's (1917) study of 6th graders' errors in reading paragraphs. He reported that students read passages and failed to monitor their comprehension and even stated that they understood the reading whether they did or did not. He compared the novice students' mistakes in comprehension to the thoughts an expert reader might have while reading. The students would correct their mistakes if they were pointed out, but "they do not, however, of their own accord test their responses by thinking out their subtler or more remote implications" (1917:331).

Thorndike's work on types of courses that improve the ability to think has had an impact on research in areas leading to mathematical cognition (Schoenfeld, 1992:346). He found that effect size of improved thinking was not due to types of courses studied (i.e., mathematics and languages), the then traditional point of view, but that "those who have the most to begin with gain the most during the [school] year" (Thorndike, 1924:95). Good thinkers became better thinkers no matter what subject they studied.

Another area of research that began in the 1950s with the invention of computers—artificial intelligence—refuted importance of the then popular behaviorist movement and renewed study of cognition, focusing on metacognitive skills. Information processing looked at the structure of memory, knowledge representations and retrieval processes, and problem solving rules. In a preface to a collection of edited PhD theses Minsky (1968) defined artificial intelligence as "the science of making machines do things that would require intelligence if done by men". Minsky explained that in order to make non-cognitive computers process cognitive information, researchers had to go beyond the behaviorists' point of view—input-output observables—to mentalists' descriptions of thought processes, which could also be called human cognition skills. This new focus on the importance of human cognition supported the importance of humans reflecting on their cognitive processes (metacognition), but ". . . it was not until the early 1980s that control and other aspects of metacognition began to be a focus of attention for mathematical problem-solving researchers" (Lester, 1994:671). Tulving and Madigan initiated the research field with metacognitive processes in their investigations into human memory (Campione, Brown, & Connell, 1989:93-114) and John H. Flavell (Flavell, Friedrichs, & Hoyt, 1970:324-340) transferred the interest in what humans know about their own memory to what they know about their own cognitive processes. He is credited by many cognitive researchers (Brown, 1987; Campione, Brown, & Connell, 1989; Lester, 1985; Schoenfeld, 1992) as the "Father of Metacognition". His somewhat lengthy description of metacognition is often cited as a starting point for studies in mathematical problem solving (Garofalo & Lester, 1985; Lester, 1985; Schoenfeld, 1985, 1992).

Metacognition refers to one's knowledge concerning one's own cognitive processes and products or anything related to them, e.g., the learning relevant properties of information or data. For example, I am engaging in metacognition (metamemory, metalearning, metattention, metalanguage, or whatever) if I notice that I am having more trouble learning A than B; if it strikes me that I should double-check C before accepting it as a fact; if it occurs to me that I had better scrutinize each and every alternative in any multiple-choice type task situation before deciding which is the best one; if I become aware that I am not sure what the experimenter really wants me to do; if I sense that I had better make a note of D because I may forget it; if I think asking someone about E to see if I have it right. Such examples could be multiplied endlessly. In any kind of cognitive transactions with the human or nonhuman environment, a variety of information processing activities may go on. 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 (Flavell, 1976:232).

In addition, Flavell (1987) outlined three categories of metacognition with person variables (intra-individual, inter-individual, and global), task variables, and strategy variables. Person variables include information about what we know about ourselves and others when learning. Task variables are knowledge about a specific domain's concepts. And strategy variables are what we know about manipulating domain concepts to answer a question. "Metacognitive knowledge involves the interaction of person, task, and strategy" (Garofalo & Lester, 1985:168). According to Flavell, metacognition is helpful for any organism that thinks a lot; makes mistakes, needing self-regulation to correct; wants to communicate with other organisms; needs to plan ahead; makes decisions; and/or needs to explain phenomena (1987:27). His reflections connect metacognitive problem solving skills to the constructivist learning theory. Both place importance on reflection and critical thinking within the social realm of learning.

Most simply, metacognition is knowing about knowing, and it is most broadly defined as awareness and control of one's cognition (Baker & Brown, 1984; Flavell, 1976, 1987; Gourgey, 2001). As pointed out by Paris and Winograd (1990:7-15), since cognition includes all human mental activities, it is rather difficult to give the notion an operational definition, and researchers emphasize different aspects of it and adopt different terminology all attempting to better illustrate the concept. Flavell (1978, 1987) discussed metacognition from the perspectives of metacognitive knowledge and metacognitive experience, and emphasized the learner's metacognitive knowledge about the variables of person, task and strategy. Brown (1978, 1987) and Baker and Brown (1984) laid more emphasis on the learner's executive control of cognition, including the regulatory activities of planning, monitoring, testing, revising, and evaluating. Paris, Lipson, and Wixson (1983), and Paris and Winograd (1990) proposed self-appraisal and self-management of cognition as two essential features of metacognition (see also Jacob & Paris, 1987:255-278). They described metacognitive knowledge in terms of declarative, procedural, and conditional knowledge; namely, one's cognitive self-appraisal answers questions about "what you know, how you think, and when and why to apply knowledge and strategies" (Paris & Winograd, 1990:17). More recently, Schraw (2001), Schraw and Moshman (1995) defined metacognition as knowledge and regulation of cognition; they divided the former into three kinds of awareness, i.e., declarative, procedural, and conditional knowledge, and focused one's metacognitive regulation on planning, monitoring, and evaluating that help learners control their cognition. I concur with this latest definition and propose three guidelines for EFL writing instruction based on the theories of Paris and Winograd (1990), taking into account all three kinds of metacognitive knowledge and metacognitive regulation.

2.1.2 Metacognition and learning

Metacognitive awareness and self-regulation are of great importance in learning because learners will be able to reflect upon and monitor their cognitive activities, and further develop and employ compensatory and corrective strategies to review and regulate the activities if they are aware of their mental activities. According to Vygotsky (1978), at an early age young children may talk to themselves when encountering difficulties for the purpose of self-guidance and self-direction. The monologues help children reflect on their own behavior and plan alternative actions. As children get older, the self-directed monologues will gradually become internalized as silent, inner speech. Later, researchers have found abundant evidence to support Vygotsky's assumptions and concluded further that the children who talk to themselves, or monitor themselves in terms of metacognition, when facing a challenging task tend to outperform those who do not think about their own cognitive behavior. This cognitive development observed by Vygotsky and other researchers thus lends strong support to the importance of teaching students how to know about and regulate their cognition.

In the last two decades, researchers have attempted to prove that metacognitive learners are beneficial not only in general learning but also in specific subject areas such as reading, writing, mathematics, social studies, and problem solving. They have also attempted to discover the metacognitive knowledge and strategies that students need to be equipped with in order to gain metacognitive awareness and make metacognitive judgments and choices (Baker & Brown, 1984; Brown, 1978, 1987; Gourgey, 2001; Paris & Winograd, 1990; Schraw, 2001). In the field of language learning, Wenden (1998, cited in Zhang, 2003) asserted that learners' metacognitive awareness played a part in the effectiveness of learning.

2.1.3 Scaffolded instruction

Scaffolding is based on Vygotsky's (1978) concept of the zone of proximal development. The concept is

"the distance between actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers… The zone of proximal development defines those functions that have not yet matured but are in the process of maturation, functions that will mature tomorrow but are currently in an embryonic state".

(Vygotsky, 1978: 86)

In other words, scaffolding involves providing support to students to bridge the gap between what they can do on their own and what they can do with guidance from more competent others including teachers and peers. The reciprocal teaching model, which is developed to teach students reading comprehension strategies, is based upon this concept of scaffolding (Palincsar & Brown, 1989:117-131).

Resenshine and Meister (1992:26-33) identified six basic guidelines for the teachers planning to practice scaffolded instruction: (1) present new cognitive strategies; (2) regulate any difficulties during guided practice; (3) provide varying contexts for students to practice; (4) provide feedback; (5) increase student responsibility; and (6) provide independent practice. Accordingly, at the beginning of teaching students how to perform a new task, the teacher needs to firstly model how to provide the students with complete guidance. The students observe the teacher, an expert model, and do little independent thinking at this point. Afterwards, the teacher provides guided practice in different contexts for the students to practice the strategies modeled in the first step. At this stage, the students attempt to perform the task with the support supplied by the teacher. The support can include the teacher providing additional modeling or thinking aloud, offering hints and feedback, and giving partial solutions. As more guided practice is conducted, the teacher gradually transfers the responsibility to the students by decreasing the amount of support and increasing the students' independent thinking. That is, the teacher's role changes from model to facilitator, and the practice changes from teacher's control to students' self-regulation. Finally, when the strategies are internalized, the students are able to perform the task on their own. Scaffolded instruction is considered effective to develop students' metacognitive knowledge and strategy (Paris and Winograd, 1990:7-15).