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# Effect of Prompted Reflection and Metacognitive Skill Instruction on University Freshmen's Use of Metacognition

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Effect of Prompted Reflection and Metacognitive Skill Instruction on  
University Freshmen's use of Metacognition

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A dissertation submitted to the faculty of  
Brigham Young University  
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

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## ABSTRACT

### Effect of Prompted Reflection and Metacognitive Skill Instruction on University Freshmen's use of Metacognition

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Doctor of Philosophy

Research in metacognition has long demonstrated that applying metacognitive strategies improves students learning and performance. Incoming college and university freshmen are not typically trained in using the metacognitive skills that could enhance their academic performance and their satisfaction with the college experience. This study attempted to assess first-year university students' metacognitive awareness and usage at two levels: (a) After direct and specific metacognitive training, (b) after engaging in weekly metacognitive reflection assignments. Six classes of university freshmen were studied in terms of their use of metacognitive skills and strategies as they progressed through their initial semester. Four of the six classes were trained in metacognitive skills and strategies using the Metacognitive Skill Instruction. Two of these four classes were prompted to specifically reflect on their use of metacognitive skills and strategies. The other classes were not prompted about their use of metacognition. Students' metacognitive performance was assessed at the end of the semester using the Metacognitive Awareness Inventory. Results show there was no initial difference between groups yet a significant difference between posttest and retrospective pretest scores was found for all three groups at the end of the term.

Keywords: metacognition, reflection, university freshmen

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*“As we recognize our own thinking process it changes the way we view things.”*

*Emily Ward, Freshman Academy peer mentor, personal conversation 2/14/07*



## CHAPTER 1: INTRODUCTION

Although schooling serves many different purposes, such as helping students (a) learn how to learn, (b) cope with ambiguity, (c) think like professionals, and (d) develop a sense of responsibility, two major goals of educational programs are to teach general skills for problem solving and to instruct students in domain knowledge (Ackerman & Lohman, 2006; McCormick, 2006). In traditional classrooms, teachers communicate knowledge by lecture and demonstration, while students take notes, observe, perform drills, memorize, and take tests. Although these strategies characterize the traditional approach to teaching and emphasize rote learning, research has identified that “*understanding* [italics added] not memory should be the goal of instruction” (Alexander & Winne, 2006, p. 5).

Two reports from the National Academy of Sciences (NAS, 2000, 2005) have identified three principles of learning that are important for helping students develop understanding. These principles include (a) engaging students’ preconceptions of how the world works, (b) developing a deeper understanding of content knowledge, and (c) teaching metacognitive skills that can help students learn to manage their own learning by defining learning goals and actively monitoring their progress in achieving them (Alexander & Winne, 2006). This study focused on this third principle.

According to Everson and Tobias (2001), as well as Matanzo and Harris (1999), many students entering college have not been taught strategies for examining or improving their metacognition. In fact, a study of pre-service teaching students conducted by Matanzo and Harris reports that many students do not even know what metacognition is. In his study that examined how teachers teach metacognitively, Hartman (2001) contends that students cannot be expected to be competent with metacognitive skills because these skills are rarely taught

explicitly and not everyone develops them independently. He also reports that many students experience academic difficulty because they constantly focus on retaining subject matter content without first learning the metacognitive skills needed to support that effort. Wilburne (1997) asserts that the teaching of basic learning skills normally focused on in junior high and high school settings (i.e., (a) note taking, (b) observing, (c) drilling, (d) memorizing, and (e) test taking) is not enough for successful performance on complex academic tasks found at the college and university level.

For more than 20 years, research reporting the positive effects of enhancing metacognitive usage among students has been published in reference to many academic subjects, including writing (Gordon & Braun, 1985), the arts (Borkowski & Muthukrishna, 1992), mathematics (Muchlinski, 1994), reading (Hacker, 1998), problem solving (Davidson & Sternberg, 1998), teacher education (Matanzo & Harris, 1999), linguistics (DeLao, 2001), and college instruction (Everson & Tobias, 2001). The resulting conclusion from these studies is that explicit instruction about metacognition may greatly benefit students.

Research also reveals that a large, often subconscious, component of metacognition is the internal reflection that metacognitive users engage in to clarify and refine tasks they are working through or have completed (Cornoldi, 1998). Although this process is rarely verbalized and many times hidden from the user's conscious thought, researchers (Harrison, Short, & Roberts, 2003; Hoffmann, 2000; Jing, 2006; Kuiper & Pesut, 2004; McAlpine, Weston, Beauchamp, Wiseman & Beauchamp, 1999) call attention to conscious reflection in their studies and argue that learners need to bring the metacognitive thoughts and ideas they use during task completion to the forefront of their consciousness so that these hidden values and judgment calls can be evaluated for their effectiveness. Only then can learners begin to make deliberate choices about

what they will and will not do metacognitively. These researchers further stress that reflective learning can make a significant contribution to student development in that explicit promotion of reflection has been found to be particularly important in helping students become (a) self-directed, (b) self-aware, (c) self-reinforcing, (d) self-evaluative, and (e) good independent learners, in essence, metacognitive learners.

In their study on student reflective thinking in earth and environmental science classes, Harrison et al. (2003) contend that many articles promote the use of metacognition in the classroom and many extol the virtues of reflection, but none combine the two and encourage or specifically research reflection as an aspect of metacognition in first-year college or university freshmen. A more recent integrative review of published literature in educational psychology and various other educational domains—such as nursing, teacher education, engineering, and English as a second language—identified 84 peer-reviewed articles that alluded to or vaguely touched on the effects of reflection as a minor element of metacognition.

While strategies to facilitate cognitive activity and reflective practice have been used in isolation from each other, there is evidence to suggest (Harrison et al., 2003) that they are inextricably linked. Harrison et al., as well as Hoffman (2000), who focused his studies on metacognition and the arts, offer empirical evidence wherein they contend that experts in their respective fields have an awareness and usage of metacognitive skills, as well as reflective thinking skills, that run parallel with each other. They further assert that for students to begin thinking and acting like experts they must engage in the seldom used practice of putting their own learning at the center of the question, as the object of their own reflection, as opposed to simply concentrating on course content matter. Thus, student reflection on metacognition needs to be promoted in the classroom, and the effects thereof and association between metacognitive

behaviors and student reflection need to be specifically measured in an attempt to fill this gap in the literature. This study attempts to contribute to the literature by assessing the performance of three groups of students in a University 101 course who were exposed to different levels of metacognitive skill instruction and reflection.

### Statement of Purpose

The purpose of this study was to estimate to what effect direct metacognitive instruction coupled with explicit reflection on that instruction had on university freshmen's metacognitive awareness.

### Research Hypotheses

The study focused on three hypotheses.

1. Freshmen who complete the University 101 course will demonstrate greater metacognitive awareness at the end of the course than at the beginning of the course.
2. Freshmen enrolled in University 101 who receive direct metacognitive instruction will demonstrate greater metacognitive awareness after completing the course than freshmen enrolled in University 101 who do not receive such instruction.
3. Freshmen enrolled in University 101 who are required to explicitly reflect on the metacognitive instruction they received while answering weekly metacognitive reflection assignments will demonstrate greater metacognitive awareness at the end of the course than freshmen enrolled in University 101 who were not required to explicitly reflect on the metacognitive instruction they received.

This research should be particularly important to those who teach or find themselves working with college and university freshmen. Dearnley and Matthew (2007) and Leamson (1999) report that this population does not know what to expect when they enter college and

many may not possess the skills needed at this level to successfully complete their first year of studies.

## CHAPTER 2: LITERATURE REVIEW

### Metacognitive Characteristics of First-Year University Students

Research reveals first-year college or university freshmen are, on the average, unaware of their own metacognitive strengths and strategies (Matanzo & Harris, 1999). Metacognitive instruction is typically not provided in the usual high school environment. Metacognitive instruction is also generally not provided in tertiary settings despite research (Leamnsen, 1999) that shows how important having a learning orientation is to university success. The lack of metacognitive instruction is startling given Leamnsen's findings that most first-year college students do not know how to (a) listen well, (b) make notes on what they hear, (c) read with comprehension, or (d) write referentially (all of which are skills that lead to university success).

Instead, Leamnsen (1999) shows that freshmen are more likely to depend on the use of basic study skills taught at the middle school and high school level which focus mainly on simple tactics such as (a) note-taking, (b) recitation, (c) scheduling, (d) rewriting lecture notes, (e) re-reading assignments, (f) highlighting key concepts, (g) making flash cards, (h) using mnemonic devices, (i) summarizing with outlines and charts, and (j) studying old exams. The deficit in metacognitive use and over reliance on surface learning leads one to understand why deep learning may not be taking place on a large scale at the secondary level of schooling (Wilburne, 1997).

Research has revealed that there are several recurring themes of metacognition in the activities of college students. Hoffmann (2000) reports that for whatever reason, "many college students have difficulty in figuring out a right strategy to learn in the many courses they take.

Even after the instructor adopts good instructional practices that supposedly help students learn content specific information, learning may not occur fully unless a student learns to monitor his or her own learning” (p. 380). Second, Lovrich (2004) claims that “students often believe that if they just think harder about a problem a solution will follow. However, thinking about one’s thinking can be a more productive expenditure of mental energy” (p. 57). Third, Dearnley and Matthew (2007) report that “we must remember that these students are starting from the position of being silent receivers of knowledge instead of actively generating their own knowledge” (p. 383). These comments support Jing’s (2006) findings wherein he contends that “students previous exposure to the transmission approach to teaching in the secondary schools may have affected students’ conceptions of learner-teacher roles and may affect student’s readiness for autonomy” (p. 99) as well as student’s acceptance to reflective ways of learning.

Hartman (2001) reports that students who don’t progress past the acquisition of basic study skills lack the metacognitive knowledge needed at the college level and “seem to have little knowledge of what they are doing when performing a task” (p. 35). These students generally have a hard time performing the following learning tasks:

1. Determining the difficulty of a task
2. Monitoring their comprehension effectively
3. Planning ahead
4. Monitoring the success of their performance
5. Using all relevant information
6. Using a systematic step by step approach to completing a task
7. Curtailing the frequent jumping to conclusions
8. Using adequate or correct representations

Another academic failing common to this population is that many students consider knowledge not as something to be used to answer a question but as something that is the answer to a question (Leamnsn, 1999). Subtle as this may be, this distinction exposes a difference that is real and significant.

Couple the above academic shortcomings of this population with the major adjustments college demands of first-year students (i.e., (a) leaving home for the first time, (b) finding themselves in a foreign environment that does not mirror the academic settings they are accustomed to, (c) facing the challenges of modifying long standing academic habits, (d) interacting as adults with their teachers, (e) coping with the excitement of unsupervised freedom, and (f) making new friends) and it is not hard to see why many incoming freshmen do not perform up to their usual level of achievement in their first year in a tertiary setting. Performing poorly or even failing in this initial term may cause students to fear that they are not up to the rigors of a higher education and thus make a premature decision to leave school and give up their goal of obtaining a college education (Leamnsn, 1999).

Nonetheless, an equally important assertion is that despite the many academic inadequacies that students initially bring with them to their first year in college, these students are capable of learning to do those things that can substantially direct their efforts towards success. Research by Cooper (2004), Dearnley and Matthew (2007), Hartman (2001), and Leamnsn (1999) emphasize the importance of active learning and self-management of learning at the college level. The need for better self-management implies a need for greater metacognitive awareness of one's personal resources. Thus, metacognitive skill instruction, coupled with overt student reflection on their use of metacognition, may be helpful in alleviating students' (a) ineffective approaches, (b) feelings of failure, and (c) unrealistic expectations in

regards to higher academic tasks, as well as (d) “counter the reality that many of these incoming students do not appreciate the importance of intellectual struggle, incubation, and understanding of ideas over simply following pro-offered procedures” (Hartman, p. 43). Dearnley and Matthew contend that instruction for this class of student should focus on the metacognitive skills of learning, thinking, and problem solving, as well as the opportunity to reflect on this learning in an effort to assist this population in successfully meeting the increased academic demands they will encounter in this higher educational setting. By teaching students how to learn, students may attain the deep understanding that NAS contends to be vital to learning as well as promote student engagement with the processes of knowledge production. Dearnley and Matthew believe such efforts would contribute to successful student outcomes including development of the skills, knowledge, and motivation required for independent learning and autonomous professional practice.

Dearnley and Matthew (1999) assert that positive results occur through changing the way this population thinks about their learning and knowing.

As the fear of failure reduced, so did the dependency on surface learning. Becoming reflective was fundamental in enabling the students to challenge their existing notions and ideas about learning as they began to value their own existing knowledge. In short, students began using themselves as an instrument of knowledge formation as well as understanding knowledge development. Reflection contributed greatly towards increased self-esteem and self-awareness as students realized that they could learn and they could know. It increased confidence in the ability to organize things for themselves, and motivation was driven by the sense of achievement. Students were liberated to trust in



their own ability to think, to learn, and to act autonomously...thus experiencing successful outcomes in terms of student attrition, academic attainment, practice development, and motivation for study. (p. 388)

Other researchers (Cooper, 2004; Hartman, 2001; Hoffman, 2000; Jing, 2006; Wilburne, 1997) echo Dearnley and Matthew's (1999) call for further explorations of these relationships which connect student's ability to reflect about their thinking to academic success in different disciplines and levels of study. Thus, further exploration of the impact of reflection and the successful application of metacognition could help us understand successful transitioning to the university setting.

#### Nature of Metacognition

A review of the literature reveals that the most widely accepted definition of metacognition is knowledge that includes (a) awareness of one's personal abilities (declarative knowledge), (b) general strategies that might be used for different tasks (procedural knowledge), and (c) knowledge of the conditions under which these strategies might be used, as well as knowledge of the extent to which the strategies are effective (conditional knowledge) (Flavell, 1979; Pintrich, Wolters, & Baxter, 2000; Pressley, Van Etten, Yokoi, Freebern, & Van Meter, 1998).

McCormick (2006) further breaks down this definition and delineates the characteristics represented within the three different types of metacognitive knowledge. The first, declarative knowledge includes knowledge about oneself as a learner and about what factors influence one's performance. Good learners appear to have more knowledge about different aspects of memory, such as capacity limitations, rehearsal, and distributed learning. The second is procedural knowledge and refers to knowledge of how to do things. Much of this knowledge is represented

as heuristics and strategies. Individuals with a high degree of procedural knowledge perform tasks more automatically, are more likely to possess a larger repertoire of strategies, to sequence strategies effectively, and qualitatively use different strategies to solve problems. The third is conditional knowledge, which refers to knowing when and why to use declarative and procedural knowledge. Conditional knowledge is important because it helps students selectively allocate their resources and use strategies more effectively. Conditional knowledge also enables students to adjust to the changing situational demands of each learning task.

McCormick (2006) goes on to state that there are also three gradations or levels of metacognition that individuals possess.

Tacit elements of metacognition are implicit, acquired or constructed without any explicit awareness. Because learners are not aware of them, these implicit frameworks are not accessible for verification and may persist even when incorrect or maladaptive. Next is an informal level of metacognition. Informal elements of metacognition are fragmentary. Learners are aware of some of their beliefs and assumptions but they have not yet constructed an explicit theoretical structure that integrates and justifies these beliefs. And finally, formal levels of metacognition are highly systematized accounts of phenomenon involving explicit theoretical structures. Users of formal metacognitive operations are aware of their purposeful efforts to construct and modify metacognitive theories. (p. 4)

This study adopted the above definition of metacognition and its various expansions and categories as it applied to the knowledge first-year college students' have of their own thinking and the skills and strategies they use to monitor that thinking on college level academic tasks.

The research of Hartman (2001), McCormick (2006), as well as Schraw and Dennison (1984) identify four main types of strategic knowledge that are essential for students to learn to

become effective metacognitive thinkers. These components include (a) planning, which helps the learner define what the problem is, and select an appropriate solution strategy, (b) monitor the effectiveness of the solution strategy, and (c) regulate themselves while learning in order to identify and overcoming obstacles to solving the tasks in front of them and (d) evaluating the end results. These four key components and the elements they include are shown in Table 1.

### *Importance of Metacognition to Learning*

According to Leamson (1999), on average only about half of the matriculating first-year college students in the United States ever graduate. This sizable attrition rate suggests that students who come directly from secondary education are not well prepared in a number of areas for college learning. One reason they may flounder may not be because they lack knowledge but rather strategies for using what they know to attain success by metacognitively guiding their learning. Therefore, to help these students gain the study skills necessary to move from surface learning to deep learning, teaching the metacognitive skills and strategies of planning, monitoring, regulating and evaluating, coupled with explicit reflection, is a viable option teachers can introduce (or reintroduce) to this population. Hartman (2001) claims that student's perceptions of the amount of personal control they have over their own learning have important implications for student retention. He reports that a number of studies claim significant improvement in student learning when regulatory skills, like those emphasized in metacognitive instruction, as well as an understanding of how to use these skills, are included as part of normal classroom instruction.

He also contends that introducing or making explicit the metacognitive skills that incoming university freshmen already possess has been reported to improve student performance in a wide range of areas including better use of (a) attentional resources, (b) existing strategies,

Table 1

*Key Metacognitive Elements*


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Constructs	Indicator Behaviors
Planning	<ol style="list-style-type: none"> <li>1. Making predictions</li> <li>2. Being aware of what is already known so appropriate strategies can be selected</li> <li>3. Sequencing those strategies</li> <li>4. Allocating time and attention that affect performance</li> </ol>
Monitoring	<ol style="list-style-type: none"> <li>1. Identifying the task</li> <li>2. Checking one's on-line awareness of comprehension and task performance</li> <li>3. Deciding whether, in light of new information, a path already taken should be abandoned and what, if anything, can be salvaged from an abandoned attempt</li> <li>4. Looking for previously overlooked information and identifying ways to combine information</li> <li>5. Predicting the eventual outcome</li> <li>6. Engaging in periodic self-testing</li> </ol>
Regulating	<ol style="list-style-type: none"> <li>1. Allocating resources and number of steps needed to complete a task</li> <li>2. Being mindful of the intensity and speed with which a task must be completed</li> <li>3. Using existing strategies to the learner's best advantage</li> <li>4. Increasing awareness of comprehension breakdowns</li> </ol>
Evaluating	<ol style="list-style-type: none"> <li>1. Determining the efficacy of one's efforts</li> <li>2. Self-reflective thinking about experiences and situations to determine if knowledge is adequate</li> <li>3. Determining what goals are to be set in light of one's self-efficacy</li> </ol>

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(c) time management, (d) test taking, and (e) awareness of comprehension breakdowns. Hartman argues that the use of metacognition is essential to learning in that “students will learn, retain, and transfer what they learn more effectively after being trained in the use of metacognitive skills and strategies than when compared to implementing a discrete skills approach to learning” (pg xiii).

Runco (2004) takes the argument one step further and asserts the following:

The critical distinguishing characteristic of metacognitive processes may be their controllability. Individuals can monitor and manipulate metacognitive processes. This distinguishes them from basic cognitive processes. If individuals have control over these processes, they (and those working with them) can do something about them as decisions lead very directly to actual performance. (p. 21)

This statement implies that since we have control over how or if we use our metacognitive knowledge, there is no excuse then to ignore our ability to refine, enlarge and strengthen it.

Research reveals a difference between those students who use metacognitive strategies and their peers who do not. Smilkstein (2003) reported that one important difference is that “metacognitive learners separate their intellectual capacity from their lack of knowledge and have confidence in their ability to learn when and if given the opportunity to experience or be exposed to a particular object of learning” (p. 111). One study, which focused on teaching metacognition to pre-service education students, (Wilburne, 1997) found that those students that were taught metacognitive skills consistently scored higher on tests and showed significant improvement in other cognitive processes associated with learning over other students that were not taught metacognitive skills. Cooper (2004), researching metacognition in older, returning college-age students, and Gott, Lesgold, & Kane, (1996), who studied student transfer of

technical competence, all report that metacognitively aware students are more active and independent as learners, engage in more reflecting, monitoring and assessing of their actions and cognitive processes than their less metacognitively aware peers who were found to be more passive and instructor-dependent.

These researchers also report that when metacognitively aware students are compared to peers who are less metacognitively aware, those with high metacognition out-performed those with low metacognition, regardless of overall attitude, thus indicating that metacognition and general aptitude appear to operate as independent processes.

These findings suggest that metacognitive knowledge plays a compensatory role that students can use to enhance their learning, leading both Cooper (2004) and Gott et al. (1996) to claim that a student's knowledge of metacognitive skills and strategies may predict learning performance.

There are other benefits to the teaching of metacognitive knowledge that look beyond helping students become more successful and thereby possibly curtailing student attrition rates. Sigler and Tallen-Runnels (2006) claim that identifying the basic mechanisms of an individual's metacognitive behaviors may lead to the creation of methods to help improve learning for that individual.

#### *The Differences between Metacognition and Cognition*

For the purpose of this study, it is important to differentiate between metacognition and cognition, as well as between metacognition and critical thinking. Hartman (2001) explains the differences between metacognition and cognition in that "cognitive skills tend to be encapsulated within domains or subject areas, whereas metacognitive skills appear to be more durable and span multiple domains" (p. 8). He claims further that "While high levels of domain specific

knowledge may facilitate the acquisition and use of metacognition, domain knowledge does not guarantee higher levels of metacognition and students need to understand the distinction between cognition and metacognition to become self-regulated.” This implies that cognitive skills are necessary to perform a task within a domain, while metacognitive skills help a student strategize how the task will be performed. Cornoldi (1998) reports that cognition is affected by the metacognitive conceptualizations preceding and metacognitive knowledge triggered by specific tasks. He asserts that “introspective evidence shows that engagement in cognitive tasks is typically accompanied by metacognitive reflection concerning the task, thus metacognitive knowledge is not a by-product of cognitive activity” (p. 152).

#### *The Differences between Metacognition and Critical Thinking*

Alexander and Winne, editors of the Handbook of Educational Psychology (2006), delineate the difference between metacognition and critical thinking by declaring that critical thinking skills are targeted on incoming information and reflecting on what is offered as supporting evidence and includes how that knowledge can be verified, while metacognition is targeted on internal abilities and personal information that focuses on the decision or strategic process of what to include, leave out, alter or seek out in an effort to complete a task or further a process.

Metacognition and critical thinking include steps that are similar in that they both (a) encourage the analyzing and evaluating of thinking from the viewpoint of improving it, (b) promote self-direction, (c) require self-discipline, (d) entail self-monitoring, and (e) require self-corrective activities that help the learner strive towards clarity, accuracy, precision, relevance, depth, breadth, and logic of information. However, metacognition differs from critical thinking in that metacognition is a strategic process that focuses the student’s

thoughts inward and makes the learner an active agent of his or her own learning, while critical thinking is an analytical process that focuses the student's thoughts outward towards an evidence of the information provided. Critical thinking does not necessarily entail an evaluation of the criteria-selection process that is an inherent aspect of metacognition.

### Challenges Associated with Teaching Metacognition at Various Educational Levels

A number of problems associated with teaching metacognition have been identified in the literature. Studies indicate that teaching students how to monitor their behavior can be difficult. Jing (2006) found that when students who were learning English as a second language were asked to explicitly reflect on the metacognitive skills and strategies they used "some of them did not easily see how reflection and metacognitive knowledge could contribute to progress in their learning goals" (p. 106). Jing says that the use of metacognition was basically seen as a fundamental leap in these students' learning, however, some students voiced that even if they became aware of their learning processes they could not see how it helped their learning, since what they wanted was quick results. They wanted necessary information transmitted to them so all they had to do was commit the information to memory without challenging it or analyzing it to get the full understanding of it. Both the act of reflecting as well as the learning of metacognitive skills and strategies were seen by some students as a waste of time. Jing further states (p. 107) that students might not be psychologically ready for the "strangeness" of the autonomy such metacognition supports. Matanzo and Harris (1999) found that those students who had the most negative attitudes towards the subject of metacognition at the beginning of the study were those students who were the most resistant to change throughout the course.

A second problem found with teaching metacognition is also reported by Wilburne (1997). She states that this type of teaching is harder on the teacher in that it can take a large



amount of time away from the teaching of content knowledge. Also, many times it is hard for teachers to explicitly verbalize to their students what they are thinking and how they processed information as they worked through it initially and now have to re-rehearse those thoughts overtly to their students in a way that shows the student their step-by-step mental processes of planning, monitoring, regulating and evaluating.

A third problem identified by Wilburne (1997) is that not all studies that set out to show that metacognitive skills and strategies increase student academic behaviors find this assumption to be true. She found that pretest/posttest measures of problem-solving ability did not increase more for metacognitively aware students than for the control group, although attitude from pretest to posttest did show significant increase for the metacognitive group and not for the control group.

Despite the problems found with explicitly teaching metacognitive skills to students, it is noticeable from the literature that schools have been attempting to teach metacognition to students of all ages for a number of years.

#### *Elementary School*

A review of the literature reveals that the basic components of metacognition (planning, monitoring, regulating, and evaluating) are focused on by teachers most explicitly in the early grades, even with students as young as 5 and 6 years old (Annevirta & Vauras, 2006; Borkowski & Muthukrishna, 1992; Walters, Seidel, & Gardner, 1994). Studies conducted by Annevirta and Vauras, Borkowski and Muthukrishna, and Walters et al. found that teachers devoted a number of class hours to teaching young students planning skills, such as the importance of making predictions, being aware of what is already known about a topic under discussion, and sequencing steps to complete a project. To assist these young students learning monitoring

skills, teachers helped students learn how to identify the task at hand either individually or as a group. Many times, as teachers helped students work through a task, the process of deciding whether, in light of new information, a path already taken should be abandoned and if anything could be salvaged from an abandoned attempt was overtly discussed with students. The researchers also found that other skills were taught such as (a) looking for previously overlooked information, (b) finding new ways to combine information, (c) predicting the eventual outcome of a task being worked on, and (d) encouraging students to stop for a moment to engage in periodic self-testing. The teaching of regulating skills was most often seen in the context of teachers helping students identify and become aware of comprehension breakdowns, as well as the skills of evaluating or appraising the end product against a template of expectations.

Walters et al. (1994) noted that teachers in the elementary school environment revisited the metacognitive steps of planning, monitoring, regulating, and evaluating anew with the introduction of each new academic task, thus implying that teachers believe or assume that the constant re-visiting of metacognitive steps will (or at least should) eventually cement these steps automatically in the minds of the students, enabling them to exercise and transfer these skills to other tasks or projects the students encountered in other academic subject areas, as well as future grades the students will progress through.

Despite the hard work many teachers expend on teaching metacognition to this young population, there were a few problems noted. At times researchers (Annevirta & Vauras, 2006; Borkowski & Muthukrishna, 1992; Walters et al., 1994) found that teachers start out teaching metacognitive skills to their students but ended up assessing students' use of performance objectives on the task just completed, thus implying to students that it is the correct answer or end result that is of importance in learning, not the thinking and mental struggling

(metacognition) with a project that propelled the student towards the end result. For example, Borkowski and Muthukrishna conducted studies wherein teachers taught metacognitive thinking to students in ten Michigan elementary school reading classes. They cite an example involving the teaching of expository and narrative texts in which students are required to give definitions of two major kinds of texts. These researchers found that rather than asking students to reflect on how to think strategically when encountering different texts, the questions teachers asked to check student understanding required the students to give answers based entirely on content rather than on describing the processes involved in constructing meaning from a text. Thus, the researchers contend that although the teachers taught the basic components of metacognition to the students, they missed the opportunity to support that teaching since they did not ask the children to explain the deeper skills, strategies, and reflections they undertook as they worked through the project. Because of this, their assessment potentially indirectly conveyed to the students that metacognitive strategies took second place to knowing content.

Another problem found by Borkowski and Muthukrishna (1992) was that even when teachers thought they were teaching metacognitively, many times they missed the mark. The researchers give examples of teachers teaching lessons on main ideas in which the objective is for children to pick central topics out of expository paragraphs. The researchers state that teachers failed to create the broad conceptualization that thinking about the main idea of a paragraph can also be useful in determining critical story events and learning major supporting details. Thus, children did not come to understand the flexible nature of metacognitive strategies. Borkowski and Muthukrishna also report that teachers tended to teach metacognitive strategies as independent entities rather than as processes activated in conjunction with monitoring, so interdependence among strategies was not stressed.

Annevirta and Vauras (2006) conducted a longitudinal study wherein the development of metacognitive skills and knowledge of 252 children from preschool through the fourth grade were monitored, recorded, and charted over five years as these children learned and used the four key components of metacognition. These researchers defined metacognitive knowledge for this population as knowledge that a student could adequately explain to another person (i.e., teacher or peer) as to why a particular strategy was helpful in a certain cognitive activity. The most prominent feature of this study is that teachers and students both attributed a high value to metacognition in the classroom and attention was paid to it regularly without regard to subject matter. Students were routinely asked to explain how they completed a task, why they choose the steps they did over an alternative approach, what they learned from their mistakes, and asked to evaluate the completed project and to predict future difficulties. These researchers found that “focusing on metacognition as a top priority in class had results that continued at least as long as six weeks later” (p. 220).

Annevirta and Vauras (2006) also report that not all children express the same level of knowledge or ability to engage in metacognition and that the rate of metacognitive usage fluctuated over the five year study. For example, students who were rated high in self-monitoring in preschool were found to have lower scores on this same component in first grade and then student scores rebounded again in the second grade on this same component. The researchers note that those students rated lower in overall metacognitive usage in preschool developed only marginally over the space of five years, and many never embraced the last metacognitive step of evaluation, even in the fourth grade. These researchers also found that although students were able to plan, monitor, regulate, and evaluate cognitive activity at an early age this did not automatically imply that a learner could steer or direct his or her learning process

without the help of teachers or texts. They point out that “even though a student may have an understanding of their cognition, this does not necessarily guarantee they will use it” (p. 200).

The results of the above studies indicate that elementary school teachers often try to incorporate metacognitive skills and strategies into the lessons they teach, with some teachers having more success than others. The element that appears to be consistent throughout all studies for the successful teaching and learning of metacognition is placing this construct as a top priority in both the teacher’s and the student’s mind, as a part of normal classroom instruction in a way that supports transfer between subjects and between grade levels. It is also noted that although teachers regularly visited the basic components of metacognition, teachers did not often hold students accountable for reflecting on their thinking through assessment, nor did they ask students to engage in open classroom discussion about the mental challenges and struggles the student worked through as they completed assigned tasks.

### *Secondary Education*

Although training students in the metacognitive steps of planning, monitoring, regulating, and evaluating is present in many elementary classrooms, by middle school there may be less emphasis on helping students see that they are active agents in their own cognition. Walters et al. (1994) investigated student metacognitive usage in junior high and high school creative arts classes in Pittsburg public schools. Students enrolled in these classes were asked to complete their usual classroom assignments and then step back and explicitly talk and write about the metacognitive processes they went through to create more than a dozen pieces of work. Walters et al. found that students in both the junior high and senior high classes had to be introduced to what metacognition is and how they may have subconsciously applied the four key components of metacognition as they completed their assignments. This study found that students had

varying levels of success in examining their metacognitive actions. Many students reported they had never engaged in this type of task before, and others voiced that they had never been explicitly taught metacognitive strategies.

Along these same lines, Kirkwood (2000) conducted a study wherein metacognitive skills and strategies were incorporated into the teaching of a beginning computer class for 14 to 16 year olds in Scotland. Kirkwood reported that often when teachers taught metacognitive strategies to students they tended to teach the skills in specific contexts such as (a) planning for projects, (b) checking for errors, (c) self-testing for spelling or correctness of coding, etc. Students were not taught that these skills could be generalized for future use and transferred to a variety of subject matter content.

Finally, Haller, Child, and Walberg (1988) conducted a meta-analysis of 20 different studies on metacognitive instruction and reading comprehension, covering a total population of 1,553 students from second grade through eighth grade. They found that the effectiveness of metacognitive instruction and teacher coaching differed widely depending on the grade students were enrolled in.

A time line of metacognitive instruction and students' usage of this instruction provided by Haller et al. (1988) showed that second and third graders were particularly receptive to learning and engaging in metacognitive skills and strategies. This outcome may reflect the eagerness often seen in this group of students to experience new things, as well as their willingness to learn how to learn, and shifts the emphasis of learning and practicing metacognition from the teacher to the student. They then report that fourth, fifth, and sixth-grade students were found to be the least receptive to metacognitive instruction and the least willing to engage in metacognitive strategies. Haller et al. suggests that this drop in willingness may be

attributed to the fact that academic learning changes at the fourth grade level with school tasks focusing more on reading to learn instead of learning to read. Textbooks also become more abstract and have more academic content at this grade, thus the conceptual demands of instruction significantly increases as students are encouraged to shift from learning new skills to applying those skills independently to learn, reflecting the rapid change in student's abstract skills at this age.

Haller et al. (1988) then conclude their study and report that junior high students (seventh and eighth grade) were found to be the most receptive to learning and engaging in metacognitive skills and strategies. They report that many times teachers' metacognitive instruction was couched in teaching students at this level to self-question. Haller et al. found that the teachers who regularly reinforced student's attempts to continually self-question as both a monitoring and a regulating strategy had the most significant results of teaching students metacognitive skills and strategies. The researchers attribute these findings to Piaget's description of students at this age as approaching higher cognitive levels of formal-logical operations.

### *Undergraduates*

A literature review of undergraduate metacognitive use and reflection revealed that there are not many studies available for this population. Jing (2006), who conducted a study of teaching and reflecting on metacognition to Chinese students learning English as a second language, revealed that, at least for Chinese students, learning metacognition seemed to hinder rather than help. Jing reports that students admitted that although they could see the value of using metacognition, they personally were not interested in using the skills and strategies offered. These students also acknowledged that they were not looking to become self-directed learners, nor were they interested in gaining a deeper understanding of the context of the course

material; therefore, learning metacognitive skills and strategies were seen by some as a waste of time. Instead, students stated that they simply wanted the teacher to give them the information they needed to know to pass the next exam and they would commit that information to memory. This information clearly shows that many undergraduate students may miss the point of obtaining a higher education that aims to teach learners how to become self-directed learners and think like experts.

The studies outlined above indicate that attitudes towards the teaching and use of metacognition change over the years as students' progress through school. Metacognition appears to be most highly emphasized during the elementary years and then tapers off or is not addressed at all as students enter middle school. The subject of metacognition may be addressed again in high school, but it appears that many times, in an effort to get students to embrace the use of metacognitive skills and strategies, these skills are quietly couched or hidden inside other approaches, such as self-questioning, etc. This waxing and waning may explain the findings of Cooper (2004), Kirkwood (2000), and Leamnson (1999) who report that the academic skills of the traditional first-year college student are typically ineffective. For example, these students tend to have the following characteristics:

1. They care more about getting good grades than learning.
2. They focus more on memorizing than understanding.
3. They tend to be more motivated by extrinsic sources (parental and/or cultural expectations) than intrinsic factors.
5. They rarely take time to plan their study activities which may contribute to poor time management.



These findings indicate teachers cannot assume that first-year college and university students are versed in the four key components of metacognition since not all students are explicitly taught metacognitive skills and strategies while in elementary and secondary grades, and of those who are taught, many may not understand that these skills can be applied across all academic domains. Therefore, it is imperative that this population be specifically and directly instructed in the use of metacognition and encouraged to openly and explicitly reflect on this instruction as it applies to the tasks required of them in their first year in a tertiary setting in an attempt to boost student self-confidence, increase student understanding, and stem the attrition rate of this population.

#### Recommendations for Teaching Metacognition

Metacognition can have a wide and varied impact on students' affect and intellectual performance in and out of school as well as on teachers' success with their students (Hartman, 2001). Kirkwood (2000) contends that conventional teaching is unlikely to achieve the goal of enabling students to acquire good thinking skills, and this goal is not likely to be realized spontaneously, or as an incidental consequence of attempts to accomplish other goals. He argues that explicit attention must be given to the teaching of metacognition and proposes that an infusion approach, which blends explicit instruction in thinking skills and processes with content instruction using methods that enhance students' thinking and comprehension of the content, must be adopted by teachers if these skills and strategies are to be truly learned by the students we teach. He goes on to state that "Teachers must attend to how their students actually tackle their learning and not merely to outcomes" (p. 533).

Hartman (2001) claims that teachers must adopt at least two roles with regard to metacognition: first, they must help their students develop metacognitive knowledge and skills;

second they must apply metacognition to their own instruction, curriculum and assessment. He states, “Teachers should make a concerted effort to model their own metacognition, for their students. Too often teachers discuss and model their cognition (how to perform a task) without modeling metacognition (how they think about and monitor their performance)” (p. 8). Hartman (2001, p. 40) suggests that effective instruction in metacognition requires teachers to discuss and explain the following characteristics of this thinking.

1. Discuss the importance of metacognitive knowledge and regulation
2. Explain the skills or strategies included in metacognition
3. Model these skills and strategies for students
4. Give examples
5. Explain when, why, and how to use the strategies, while emphasizing the value of flexibility in selecting strategies to fit the particular context
6. Provide guided practice on a range of texts
7. Help students recognize the tacit processes they use
8. Involve students in talking or reflecting on these tacit processes
9. Give corrective feedback.

Hartman contends that “explicit explanations (i.e., what the strategy is, why the strategy should be learned, how to use the strategy, when and where to use the strategy, and how to evaluate strategy use) create student awareness, which in turn, gives students a feeling of control over their own learning” (p. 40). Such feelings have important implications for student performance and stimulate student achievement.

However, not all responsibility for student metacognitive awareness and usage rests with teachers. Once students are introduced to the concept of metacognition with its inherent skills

and strategies, the responsibility of thinking about and practicing metacognition needs to be turned over to the students. This may be accomplished via reinforcement by embedding strategy instruction in academic tasks and by specifically requiring students to report their use of metacognition as a part of the normal class assignment (Haller et al., 1988; Hartman, 2001). Kirkwood (2000) predicts that the approach outlined above will give students the leverage (knowledge of multiple strategies), awareness (tackling problems in other subjects or outside school), and the potential for transfer that is sorely needed in this population.

The present study embraced the nine points identified by Hartman (2001) above as essential for the effective teaching of metacognition. These guiding markers were included in the procedures used in this study to teach metacognition to first-year university students and encourage reflective responses to the skills and strategies contained in this instruction as students responded to weekly metacognitive reflection assignments throughout the term.

#### Nature of Reflection

Encouraging students to participate in the learning process, choose their own direction, discover their own learning resources, and plan their own course of action facilitates learning (Dearnley & Matthew, 2007). The value of reflection in education has long been recognized as helping to accomplish these goals, particularly when trying to move students from surface learning to deep learning, which is of particular interest in this study. McAlpine et al. (1999) defines reflection in their study of improving teacher instruction at the college and university level as “a process students engage in of thinking about learning by monitoring cues for the extent to which they are within a corridor of tolerance and making decisions to adjust learning as appropriate to better achieve learning goals” (p. 110). It is this definition of reflection that is

used for this study as it relates to the thoughts and mental processes students engage in during this initial term in a higher educational setting.

Dearnley and Matthew (2007) report “The awakening process, facilitated through reflection, is crucial in moving students from a state where they begin to question received knowledge and begin to think independently” (p. 382). While some traditional methods of education serve only to endorse passivity and positions of received knowledge, Kuiper and Pesut (2004) contend that “investment in reflection has benefits for learning as it assists in integrating theory with practice, promotes intellectual growth because it is cyclical rather than linear, develops skills that makes students more confident, and fosters responsibility and accountability” (p. 386). They further assert that reflection encourages student activity and thus enables greater student connection with the learning process and assists students in challenging existing ways of knowing. Thus, we see that helping students to reflect on their thinking may have helped them develop metacognitively as well. Wilburne (1997) argues that those who employ reflection exhibit one of the characteristics of individuals who are rated as superior in thinking because reflection requires engaging in abstract processing that appears to be closely tied to the development of an individual’s stage of formal abstract thinking which does not mature for many until after a student’s time in high school.

Reflection on the part of the student can occur at a number of different levels, as reported by Cornoldi (1998), Harrison et al. (2003), and McAlpine et al. (1999).

1. Reflection-for-action that is an analytical specification of need with some evaluative overtones which occurs when considering future academic actions.
2. Reflection-in-action that is an evaluative aspect of reflection that occurs

within the student as they are engaged in a particular academic action or task at the moment.

3. Reflection-on-action that is an analytical reflection that occurs after the academic action or task is completed or near completion.

According to McAlpine et al. (1999), active student reflection on academic tasks is purposeful thinking that is an essential facet of learning that, many times, mirrors the steps of active student metacognitive thinking. They explain this parallel when they state “Reflection is driven by goals, resulting in plans drawn from knowledge, leading to actions that are constantly being revised and updated as feedback is monitored and decisions lead to adjustments in actions” (p. 109). The findings of McAlpine et al. highlight the “continuous interaction between the two inter-related components of action and knowledge. Action represents the external arena in which (a) plans are enacted, (b) cognitions are transformed into behaviors, (c) goals implemented and knowledge represents the internal knowing from experience or exposure that a student possesses” (p. 106). McCormick (2006) further asserts that “One of the most promising types of intervention for facilitating the development of metacognitive skills involves reflection as a technique to make thinking processes more visible” (p. 90).

Harrison et al. (2003) contend that reflection is an important human activity and “is an essential element of the learning process that allows students to evaluate their personal strengths and weaknesses and runs parallel with metacognition” (p. 134). They go on to report that reflective thinking is the essence of metacognition and claim that “reflection promotes self-learning and self-reliance, reinforces and consolidates learning, and promotes learner responsibility and self-improvement . . . and specific opportunities and time for reflection should be given place in the classroom” (p. 143). They then argue that “Reflection is related to action

and skillful professional practice often depends less on factual knowledge or rigid decision-making models than on the capacity to reflect before taking action in cases where established theories do not apply” (p. 143), thus indicating that reflection is part of professional development and is used widely outside the halls of academia.

#### Importance of Reflection during Learning

Experience, especially when it is reflected on, is a far more effective teacher than parents, teachers, or peers (Gavelek & Raphael, 1985). Reflection can contribute to the correcting of mistakes and the refinement of learning that is sorely needed if students are to become professionals who can successfully compete in today’s global market. Studies by Harrison et al. (2003), Kuiper and Pesut (2004), and McAlpine et al. (1999) report that by reflecting students tend to progress and improve the quality of their learning experiences. These researchers also contend that educators should move beyond the rhetoric and promote and encourage reflective learning as a central component in higher education classrooms.

Many techniques may be used to explicitly promote reflection. Some of these include learning journals, portfolios, individual self-assessment tools, tutorial discussion, and personal development planning tools, etc. A reflective learning journal has been identified by Kuiper and Pesut (2004) to be one of the most widely used tools for recording reflection and a variation of such was used for this study. As a normal part of instruction in the Social Sciences learning community of a large, private, western university, students report their academic progress to teachers via weekly academic progress assignments. For two classes of students involved in this study an additional weekly metacognitive reflection assignment was required that specifically asked students to refer to the metacognition instruction they received in class and reflectively report on the mental skills and strategies they used during the week.

Harrison et al. (2003) as well as Kuiper and Pesut (2004) report that teacher-guided student reflection has been found to promote greater levels of student reflectivity with consequent student learning transformations that include (a) exposing contradictions and perceived conflict in student thinking, (b) exposing and confronting student self-distortion, (c) understanding self-imposed limitations, (d) nurturing commitment to the reflection process, (e) gaining new insights into learning, (f) helping students recognize the learning they have gained through experience, while (g) moving students from surface learning to deep learning. These researchers also report that student metacognitive insights, which evolve from analysis of narrative journals, indicated that students showed (a) awareness of the need for knowledge such as using references and resources, (b) judgments of self-improvement, (c) judgments of self-competence, as well as (d) judgments of self-reactions and self-correction strategies. They also report that, once mastered, reflective reasoning stimulated the use of self-regulated learning prompts as well as supported the development of metacognitive insights and self-management of reflective thinking in divergent situations. These reported results indicate that a key outcome of reflective learning is the highly motivated thinking learner; a student who is able to progress and take control of his or her own learning. Reflective thinking has been found to be a “key ingredient in the commitment to lifelong learning” (Kuiper & Pesut, 2004, p. 382) and is widely recognized in the literature as a concept of interest at the global level.

From a different angle, Walters et al. (1994) contend that open student reflection reveals important insights for teachers into student learning. They report that explicit student reflection helps us, as teachers, to see the nature of the enterprise from the point of view of the learner. Student reflection on the individual challenges they face on assigned tasks enables teachers to more fully support students for, as teachers, we do not know how a student grapples with the

essence of a task if they do not reveal it to us in some way. Thus, reflection not only helps students to learn from their errors as they develop competence but helps teachers see the small yet sometimes significant changes that occur as students work through a task, reaching forward on a continuum of standards, marking their successes along the way. Walter et al. goes on to explain that when students work on complex problems, and think and talk explicitly about their experiences with these problems, the work of the classroom can replicate important aspects of the work of an expert often seen in the business world.

Thus, further exploration of the impact of reflection and the successful application of metacognition on incoming university freshmen could help us, as teachers, further support those students most in need of stepping up their academic performance to the higher levels demanded of them in a tertiary setting. This proposed boost to learning skills may also produce the changes Dearnley and Matthew (2007) contend occurs when students become explicitly aware of how to improve their own learning weaknesses such as increasing student confidence and self-esteem, improved student motivation, and a re-awakening of former passions for learning thereby stemming student attrition rates.

### Challenges of Teaching Reflection at Various Educational Levels

#### *Elementary School*

Studies show that reflection can be successfully addressed in the classroom with students as young as 5-6 years of age. Walters et al.'s (1994) study of elementary school children engaged in art classes focused on asking learners, 5-8 years of age, to explicitly reflect out loud to their teachers in an informal interview about the planning, monitoring, and evaluating the child engaged in as they worked through classroom tasks. Walters et al. found that children as young as 5 years of age were able to analysis and describe difficulties and setbacks they



experienced as well as look at their successes with the insight that comes from reflecting on their experience. Walters et al. report that these reflections were more than mere judgments of accuracy in spelling, correctness of calculations, or realism in represented design, but revealed how these young students grappled with complex problems inherent in long-term projects that include many interrelated issues. They also found that as students engaged in projects they often raised their own questions and problems that revealed their individually defined challenges. Walters et al. also report that students were constantly struggling to understand, articulate, and bring to bear the criteria by which they judge the quality of their efforts against individually defined standards of quality.

### *Secondary Education*

It appears that students had a much harder time articulating the mental processes they engaged in to solve and accomplish academic tasks when students were in middle school and high school. Walters et al. (1994) conducted a study of junior high and high school students taking classes in visual arts and reports that when students in these higher grades were asked to explicitly reflect and examine their work some were able to do so but most students reported that they found the task difficult as they were not accustomed to explicitly reflecting on their academic work, having never been required to do so before.

In a study of reflection in high school students enrolled in computer programming classes in Scotland, Kirkwood (2000) also found the same results as Walters et al. (1994). Kirkwood reported that his students, ranging in age from 14–16, had a very difficult time verbalizing the mental processes they engaged in when correcting or writing simple computer programs. This finding indicates that, although students at this academic level most likely do engage in a variety of mental processes to complete or attempt to complete their assigned school tasks, the mental

acts of planning, monitoring, regulating, and evaluating are either regressed so deeply in the student's mind that they are not even aware that they are utilizing these skills, or students at this age do not acknowledge the importance these skills and strategies hold for them and don't give them the prominence they deserve when asked to explicitly relate the mental processes they used to accomplish a task (Walters et al.).

### *Problems Encountered in Promoting Student Reflection*

Four main problems appear to surface consistently in the literature in reference to student reflection. First, Harrison et al. (2003) report that because reflection is part of the thought process there is potential danger in that educators assume that all students are automatically reflective learners. Sadly, this is not so. Harrison et al. also contend that teachers assume that students are actively engaged in reflection and that this reflection is occurring effectively for everyone in the group, therefore, it is often overlooked in formal learning settings. They go on to say that "Reflection is easy to neglect as it is something that we cannot directly observe and which is unique to each learner" (p. 136). They further assert that "reflection will not occur by chance; educators need to devise exercises, techniques and tools to promote reflection" (p. 136).

The second problem identified is that it may be difficult for students to learn to verbalize their thoughts (Dearnley & Matthew, 2007). Becoming reflective is not an automatic process and students reported finding the notion difficult or pointless if not correctly guided; others simply did not know where to start. Some students expressed that they found the writing aspect of the reflection difficult and pondered over what to put down. This initial difficulty with reflective writing is common. Dearnley and Matthew report that, as students come to understand that the more they reflect the easier it becomes and the more they can see that reflection is another way of learning, students learned that they become reflective by having to reflect.

According to Cornoldi (1998) “Metacognitive reflection is not only represented by its most evident, aware, verbalizable portion; it also includes a part not so easy to verbalize that refers to affective characteristics that include: intuitions, sensations, emotions, autobiographical memories, and self-evaluations” (p. 157). A consequence of this is that “verbalizable metacognitive knowledge may not necessarily be the aspect of metacognition that most critically affects cognitive systems” (p. 157).

The third problem with student reflection is identified by Jing (2006) wherein he reports that reflection is simply an academic activity that students are not normally required to engage in and, therefore, they are not accustomed to performing the task. He goes on to state that “Reflective learning might not be well received by learners in an examination-oriented educational system” (p. 98). He further explains that students appear to focus more on their own individual agenda of gaining information as opposed to a teacher’s agenda of students learning skills and contextual knowledge. Jing reports that his students acknowledged that they merely come to school to gain the knowledge they needed to pass exams and gain information they will use in a profession. Students indicated that, although they saw the relevance of using and reflecting on the metacognitive strategies taught them, they did not like the task of writing out their reflections as the act of writing short circuited their goals of quickly gaining only that information needed to pass the next test.

A last difficulty found with asking students to engage in explicit reflection is seen as a time management issue. Dearnley and Matthew (2007) state that the quality of student reflections they received from students in their study revealed that all too often student reflection was, at best, superficial, and at worst, self-referential. They believe that there were several reasons for this. They state that students are known to apply a cost-benefit analysis to tasks

required of them with aspects of the curriculum perceived as essential receiving time allocations while those aspects of curriculum not viewed with the same high priority not receiving the time needed. Dearnley and Matthew fear that reflection is often within this last category.

### CHAPTER 3: METHOD

This study was conducted during the Fall 2008 term in the Freshman Academy (FA) program at Brigham Young University (BYU). FA is a one-semester learning communities program. Freshmen entering BYU self-selected enrollment in FA, which encompassed approximately 40 different learning communities at the time of this study. Participants for this study included approximately 227 university freshmen, both male and female, from six FA Social Sciences learning communities. For the purposes of this study, participants were grouped into one of three groups according to the University 101 Freshman Seminar class in which they were enrolled and through which the study was conducted. Students in this study may or may not be a representative sample of the learning communities within the FA program.

#### Participants

Freshmen entering BYU are typically high-achieving students with 90% of them typically obtaining ACT scores between 24 and 30 and most attaining an average high school grade point average of 3.76 or above. They come from all regions of the United States but most are from western states (retrieved from BYU website March 1, 2008).

Despite the fact that BYU freshmen have high ACT scores and GPAs, many may still have not have attained the metacognitive thinking skills and reflective thinking habits described in this study and identified in the literature (Dearnley & Matthew, 2007) as a necessary component for deep learning at the college and university level.

## Context of the Study

The FA program is a division of Undergraduate Education at BYU and supports all educational aims set forth by BYU for students to achieve including “helping students develop sound thinking skills” and “effective approaches for study and deep learning” (retrieved from BYU website, June 1, 2007). The program uses a problem-based approach to learning and encourages students to “pay consistent attention to personal progress, i.e., self-monitoring, or self-regulation by promoting student reflection, offering student development courses, and encouraging students to try multiple learning strategies” (retrieved from FA website, June 1, 2007). The mission of FA is to help “first-year students make important connections within the university during their first semester at BYU. FA strives to provide an academic environment that facilitates the development of well-rounded students and bridges the gap between high school and college” (FA Mission Statement). At the time of this study (Fall 2008), FA had approximately 40 learning communities for students to choose from, focused on either getting started in a major, fulfilling University Core (General Education) requirements, or participating in an all-Honors learning community. The Social Sciences communities involved in this study were part of the General Education category.

The researcher approached the director of FA concerning the project who expressed interest in metacognition instruction. Since the director was scheduled to teach one of several University 101 Freshman Seminar classes to students enrolled in the Social Sciences learning communities, the students in these communities were selected to participate in the study. Students enrolled in the FA Social Sciences learning communities because there were interested in studying sociology, human development, psychology, or geography and world affairs. In addition, these students (a) lived in on-campus housing, (b) had the support of one or more FA

peer mentors assigned to each community, and (c) took four classes together, including one of three sections of a University 101 Freshman Seminar class through which the study was conducted (personal communication with FA directors, June 30, 2008). FA contends that joining others in a learning community setting provides unique opportunities for learning to take place outside the classroom as students discuss and study course material in their residence halls, study groups, collaborative projects, and open discussion (retrieved FA website September 2, 2009). The intent of this study was to teach metacognition skill instruction to incoming university freshmen and gather weekly and final reflective responses from students concerning their use of this instruction.

One important element that FA routinely provides for all students enrolled in the program is support from trained peer mentors assigned to work with each learning community. Each peer mentor is a full-time student at BYU and many of them participated in the FA program themselves as incoming freshmen. Peer mentors were chosen to act in this capacity by showing that they possessed the following leadership skills (retrieved from FA website, June 1, 2007):

1. Demonstrated academic excellence and a love of learning
2. Earned high grades in a variety of general education courses
3. Worked cooperatively in a team or group setting
4. Displayed genuine care and concern for other students
5. Developed a broad understanding of campus resources
6. Completed an intensive peer mentor training program

Peer mentors act as facilitators between students in their learning communities and various campus personnel and resources. One task of the peer mentor is to facilitate opportunities for group discussions and study groups for students within their learning

community. The peer mentors' aim during the term when this study was conducted was to encourage students within their learning community to move forward on the path towards becoming disciple scholars and to accept responsibility for their own learning experience (retrieved from FA website, June 1, 2007).

FA peer mentors were especially important to this study in that they were trained in the Metacognitive Skill Instruction (MSI) found in Appendix A prior to the Fall 2008 semester. Peer mentors working with students that were enrolled in two Geography classes (Group 1) were not trained in the MSI and they did not teach it to their students since Group 1 was the control group. Instead, Group 1 received instruction on thinking skills, which is a normal part of the FA curriculum. Peer mentors of students that were enrolled in two Psychology classes (Groups 2) or two School of Family Life classes (Group 3) taught the metacognitive skills and strategies included in the MSI to the students in their respective cohorts in a classroom setting during the second week of instruction in the University 101 Freshman Seminar Class. The peer mentors of Group 2 did not refer back to the training in the MSI after this initial teaching as this group was only to be taught the instruction once and then this training was never to be revisited again. Peer mentors of Group 3 taught the MSI as described and reinforced the use of the metacognitive skills and strategies, as well as answered questions students had regarding metacognition throughout the semester. The peer mentors of Group 3 (only) also explained the weekly metacognitive reflection assignments required of this group that were intended to push their learning by asking them to apply the skills taught each week and report on that use. These weekly metacognitive reflection assignments thus reminded the students what metacognition was and refreshed their learning about it. Glenn (1989) indicates that students need help in distinguishing between what is significant in a learning situation, why it is significant, and how

this information can affect the outcome. Once such an analysis has been completed, students can be guided to use their own expanding knowledge, insight, and experience to plan, monitor, and evaluate solutions to learning problems and challenges. These steps constitute the basic process needed for effective use of metacognition.

### Instruments

Two different instruments were used in this study. The first was the Metacognitive Awareness Inventory (MAI) developed by Schraw and Dennison (1984) and displayed in Appendix B. This measure is a self-report inventory that students filled out on two occasions using a five-point rating scale. On the first occasion, the MAI was used to collect pretest data on the first day of class. On the second occasion, the MAI was used to simultaneously collect data at the end of the term as a posttest and retrospective pretest. Average completion time for the MAI is approximately 10 minutes.

The second instrument used in the study was a weekly metacognition reflection assignment to check on academic progress. While all students were asked to reflect on their learning and how they were integrating their experience and applying what they were learning to their lives, only students in Group 3 were also prompted to reflect on how they were using metacognition during that week (see Appendix C).

#### *Metacognitive Awareness Inventory*

The MAI is purported to be a measure of student metacognitive knowledge and regulation that is widely used in the field of education. It is a self-report inventory that consists of 52 statements wherein students respond on a five-point rating scale ranging from 1 (always false) to 5 (always true). Average completion time for the MAI is approximately 10 minutes.



The developers state that the MAI was designed to measure two factors. One factor (17 items) is reported to assess the students' knowledge of metacognition skills and strategies such as declarative knowledge, procedural knowledge, and conditional knowledge. The second factor (35 items) measures regulation strategies. The regulation component purportedly includes five subscales: (a) planning (goal setting), (b) information management (organization), (c) monitoring (assessment of learning and strategy), (d) debugging (strategy to correct errors), and (e) evaluation (analysis of performance and strategy effectiveness).

Statistical analysis of the MAI by Cooper (2004) and Pintrich et al. (2000) reveals that the MAI is a good measure of metacognitive knowledge and regulation. Pintrich et al. conducted two exploratory factor analysis (EFA) studies of the MAI using college students as subjects. He reports one knowledge scale (internal consistency reliability = .88) and one regulation scale (internal consistency reliability = .91). Cooper (2004) also reports that internal consistency reliability of the MAI ranged from .93 to .88 with a significant relationship between the knowledge and regulation factors. Both researchers conclude that the MAI provides a reliable initial assessment of metacognitive awareness.

The MAI was originally designed by the developers to be administered to participants as either a pretest or a posttest measure, administered separately. Due to this population's tendency to overestimate their academic abilities, known as "illusion of learning" (McCormick, 2006), the researcher obtained permission from the developer of the MAI (personal communication, August 17, 2007) to administer the measure as a pretest at the beginning of the course and then again, as a posttest and retrospective pretest questionnaire at the end of the course, with both posttest and retrospective pretest responses being represented on the same page. Administering the MAI in

this way required that an additional column be added by the researcher to the original instrument, thus allowing students the opportunity to answer each question twice on the same page.

### *Metacognitive Reflection Assignment*

The second instrument used in this study was the Metacognitive Reflection Assignment. All students enrolled in the Social Sciences learning communities of FA participating in this study were required to reflect weekly on the progress and challenges they faced, as well as the connections they made between course material and service-learning experiences, while completing various assignments during the term. Students in one group (Group 3) also received an additional weekly reflection prompt (shown in Appendix C) that asked these students to explicitly reflect on their use of metacognition as it was taught through the MSI training they received on the second week of class in University 101. Specifically, these students were asked to describe how they used the four key elements of metacognition (i.e., planning, monitoring, regulating, and evaluating their work) during the week as they completed assignments in their classes. Students were not limited to using this metacognitive reflection assignment on University 101 projects only. They were informed that this assignment could be applied to any other aspect of school work or life experiences where they believed they had actively engaged in metacognition.

### Design

This study employed a pretest-posttest nonequivalent groups research design involving three intact groups, one of which acted as an untreated comparison group. The term *nonequivalent* denotes that the six classes that made up the three groups could not be assumed to be equivalent prior to the treatment because they were not randomly assigned to the experimental conditions. Hence, the groups would likely differ in important ways even in the absence of the treatment.

In an effort to determine to what extent intact groups are similar or dissimilar, McMillan (2004) reports that researchers often use measures of other characteristics of the participants to show that even though the groups are not strictly equal there are probably no significant differences between them. Specific characteristics of the students taking part in this study are shown in Table 2 (information was provided by FA, September 24, 2009).

As can be seen, there does not appear to be any major differences between the groups. Enrollment for these groups was identical with students self-selecting to participate in a specific schedule of classes within a Social Sciences learning community.

Table 2

*Characteristics of Study Participants*

Group	N	Gender		Age		ACT Score		H.S. GPA	
		Male	Female	Male	Female	Mean	SD	Mean	SD
1	76	27	49	18.0	17.9	26.82	2.72	3.75	25
2	74	17	57	17.9	18.0	26.84	2.77	3.76	20
3	77	5	72	17.8	17.9	26.60	2.90	3.80	20

All six University 101 classes involved in the study were taught in the same general way with students in all six classes reading the same materials at about the same time, engaging in the same assignments, and completing individual and group projects all embodying the same requirements. Due to sameness in exposure (Campbell & Stanley, 1963) to course materials, assignments, projects, and time lines, these students, although all quite unique and individual in their own right, took on an element of similarity when viewed collectively as a group. Campbell and Stanley also report that “The more similar the experimental and the control groups are in their recruitment, and the more this similarity is confirmed by the scores on the pretest, the more effective this control becomes” (p. 217). It should also be noted that no student enrolled in any

of these Social Science learning communities had any foreknowledge of this study; therefore, even though the students self-selected this learning community and the section of the course, they did not self-select to participate in one of the experimental conditions used in this study.

The design included two pretests as well as a posttest using the MAI. The first pretest was administered during the second week of class to all students to allow the researcher to determine to what extent the groups initially differed (Shadish, Cook, & Campbell, 2002). The MAI was administered again to all students at the end of the semester as a retrospective pretest and posttest, administered simultaneously.

Along with the pretest, retrospective pretest, and posttest, there was one additional facet designed as part of this study. This element involved having students in one group (Group 3 only) respond to weekly metacognitive reflection assignments wherein students reported steps taken, problems encountered, and challenges overcome as it related to metacognitively working through assignments and projects over the term. Table 3 provides a visual depiction of how each group of students participated in the various aspects of this study.

The use of intact groups introduced threats to internal validity that need to be addressed (Campbell & Stanley, 1963). The first of these was the possibility of intra-session history. This refers to the unique experiences and differences that each class experienced individually (i.e., due to teacher dynamics coupled with student dynamics, etc.) which are not shared with the other classes.

The second validity threat is labeled “maturation” in Campbell and Stanley (1963) terminology. It is conceivable that students who received the MSI instruction and engaged in the weekly metacognitive reflective assignments may have become bored or believed it was too

Table 3

*Participant Groups and Treatment Received*

Group	MAI Pretest	MSI Instruction	Metacognitive Reflection Assignment	MAI Retro Pretest	MAI Posttest
1	O	~X	~X	O	O
2	O	X	~X	O	O
3	O	X	X	O	O

*Note.* O = measurable occasions; X = treatment received; ~X = no treatment.

much work to provide a detailed description each week about how they planned, monitored, regulated, and evaluated their work. Consequently students in this group may have selectively dropped or shortened their responses regarding that aspect of the assignment.

The third threat was a testing effect that is inherent with taking the same test more than once. It is possible that taking the MAI pretest may have sensitized students to the various facets of metacognition, thus focusing students' attention towards metacognitive thinking, especially those students not engaging in the MSI instruction. This may have skewed the difference between pretest to posttest scores as described by Campbell and Stanley (1963) who declared "It is quite likely that the person's attitudes and his susceptibility to persuasion are changed by a pretest. . . . taking the pretest itself could be a stimulus to effecting change instead of being the passive record of behavior it is intended to be" (p. 179).

Another area of possible concern was the use of self-report questionnaires. Such questionnaires have the advantage of being both easy to administer and easy to analyze, but they also have drawbacks. Since the MAI asked students explicitly about metacognition, it may measure a student's perception of metacognition rather than their actual use of metacognition in educational tasks. Another drawback is that self-report measures may be influenced by response tendencies such as social desirability. However, in education one is interested in generalizing to

a setting in which testing and the answering of questionnaires is a regular phenomenon. Therefore, utilizing self-report questionnaires may not have seemed out of place to the participants of this study.

#### *Posttest and Retrospective Pretest*

A retrospective pretest is a pretest administered after an intervention that asks the examinees to recall their behavior prior to the intervention. To briefly explain the reasons behind using a retrospective pretest in this design, the researcher believes it is important to further examine that facet of the design for the purposes of this study. A search of Academic Search Premier (EBSCO) revealed a number of research articles (over 3000) that reported using retrospective data from participants. These studies covered a variety of domains and included research on evaluation tools, behavioral patterns, social issues, medicine, policy making, program implementation, international relations, political issues, cultural preservation, and educational objectives, such as gauging whether and how much learning occurred over time.

Allen, Chiero, and Hoffman (2007) report that when individuals do not have sufficient information to judge their initial level of functioning (i.e., they were unaware of what they did not know) the use of a retrospective pretest may provide a more accurate measure of pre-intervention behavior. Because the evaluation is administered post-intervention, participants can apply program knowledge to form self-ratings of their pre-intervention behavior. In most cases when participants do not have sufficient knowledge to gauge their pre-intervention behavior they tend to overestimate their level of functioning, which has a negative influence on program outcome measures (McCormick, 2006). Allen et al. also asserts that when participants' pre-intervention behavior is measured retrospectively the participants generally provide more

conservative estimates of change since they have an understanding of how their level of functioning changed as a consequence of the intervention.

The retrospective pretest has been described as a useful but imperfect tool with a few weaknesses. First, it may be difficult to get completely accurate information from students due to forgetting. Second, participants may consciously override information in their memories to match their current beliefs or to agree with what they have come to believe to be a socially desirable response (Allen et al., 2007; Campbell & Stanley, 1963; Elmes et al., 1992). However, Campbell and Stanley report that retrospective pretests seem desirable as partial curbs to threats of validity that may be caused by history, selective mortality, and shifts in initial selection. Allen et al. report that using retrospective pretests helps to curb threats to validity that would have been associated with a posttest-only design, while also being a remedy for the response shift bias described above.

The large number of research studies that have reported using retrospective pretests stands as a testimony that this thinking-back approach can be successfully used. Therefore, it was hypothesized that by having students retrospectively report both their level of understanding and use of metacognition after instruction simultaneously with their level of understanding and use of metacognition prior to instruction, that students could contemplate and see for themselves their own personal growth and enhancement of metacognitive awareness and usage.

### *Interventions*

Two independent variables were included in this study. The first was exposure to the MSI (see Appendix A), a metacognitive skills instruction module developed by the researcher in 2007 specifically for use by students at the high school and college level. The second independent variable refers to the 12 weekly metacognitive reflection assignments (found in

Appendix C) required of the students in Group 3 only. A more detailed description of both tools can be found below.

### *Metacognitive Skill Instruction*

This newly constructed instructional unit was designed to help students learn and use the four key components of metacognition as identified by Hartman (2001), McCormick (2006), and Schraw and Dennison (1984), that students be able to (a) identify the task at hand, (b) determine an initial approach to the task, (c) monitor available information using information management skills and comprehension techniques, as well as (d) evaluate their work and the efficiency and effectiveness of the direction they took to complete the task.

The MSI is an easy four-step model that includes a variety of questions at each step that students can ask themselves to gain a deeper understanding and focus on the task at hand, as well as monitor their efforts as they work through completing an assignment. The MSI is designed to foster higher-order thinking skills through metacognition and provides an example of how metacognition skills and strategies can be embedded in academic disciplines with real context and taught in such a way as to encourage transfer as supported in the literature by researchers Hall and Bahrick (1998), Hartman (2001), and Matanzo and Harris (1999).

The MSI includes the following instruction and assignments that Borkowski and Muthukrishna (1992), Davidson and Sternberg (1998), Gourgey and Earisman (1998), Hartman (2001), and Wilburn (1997) have identified as imperative to metacognitive instruction:

1. Gain awareness of the importance of metacognition
2. Improve personal knowledge of cognition
3. Increase personal regulation of cognition
4. Enhance identification of skills that promote metacognitive awareness such



as (a) identify main task goals, (b) increase self-monitoring, (c) increase self-questioning, and (d) promote self-assessment

The instruction is general enough to be a usable tool that can transfer to any domain.

*Pilot test of MSI.* A pilot test of the MSI was completed prior to the Fall 2007 term at BYU with 10 peer mentors in the FA program. These peer mentors were taught specific metacognitive skills and strategies through the MSI and then asked to reflect on those items as they worked through both an in-class and out-of-class assignment.

To begin this training the researcher introduced the MSI, explained what metacognition was, and explained the purpose of the training (for peer mentors to be able to teach this instruction to freshmen under their charge). A PowerPoint presentation (much like the one in Appendix D) was shown to the peer mentors wherein each strategy contained within all four key components of metacognition was discussed. At the end of the instruction an assignment was worked through orally by the graduate instructor, using the MSI as a guide, in an effort to model for the peer mentors how the MSI might be used to complete an assignment.

To help the peer mentors come to understand the concept of metacognition and practice the skills taught an in-class assignment was designed for the peer mentors to complete after receiving the full MSI training. The peer mentors were asked to individually work through this assignment, using the MSI as a guide, while recording their reflective responses to the questions found within each of the four steps of the MSI. Peer mentors were advised to only work through Steps 1 and 2 of the MSI, due to time constraints, as Step 3 and 4 are to be used when in the midst of actually completing an assignment from start to finish.

After allowing the peer mentors to work through this in-class assignment for 15 minutes, the assignment was opened up for group discussion. The peer mentors had the opportunity to

express what they did metacognitively in trying to plan and monitor their approach as they attempted to work through the assignment. These processes of having students complete the assignment first individually, and then as a group, accomplished two important facets of metacognitive instruction. First, by having the students complete the in-class assignment privately the students were able to see, first-hand, their own individual metacognitive strengths and weaknesses. Secondly, by discussing these findings later as a group, the students benefited from peer learning as they heard new ideas and approaches other students had taken, heard of instances of back tracking as approaches became more refined, shared their individual learning strategies with each other, and benefited from exposure to new learning, planning, and monitoring strategies they may not have considered. In essence, the peer mentors worked through the MSI three times in class allowing for good, intensive, direct, and specific instruction as well as practice. Many students jotted down notes during both the instruction and the group discussion phase of this instruction to take advantage of what they learned from each other about approaches and strategies.

The peer mentors were then given another opportunity to further learn and cement the principles and strategies taught in the MSI by completing an out-of-class assignment of their own choosing and reporting the results of this assignment via Blackboard, an open communication forum used by the university. Again, the peer mentors were instructed to work through their chosen assignment metacognitively, using the MSI as a guide, writing reflective responses to the questions contained within each step of the MSI. This forum allowed students to submit their assignments to the off-campus graduate student instructor, view other students' response to the assignment, and make comments on other students' work, while allowing the graduate student instructor to interact with each student to facilitate continued group learning. Peer mentor

responses to this pilot study were favorable to both the metacognitive skill instruction received as well as the act of writing out reflective responses to questions contained within each step of the MSI.

*Use of MSI prior to this study.* The MSI instruction was then used at BYU in the Fall of 2007 with approximately 340 freshmen in several Social Sciences learning communities of FA. An end of term final personal development essay, wherein all 340 freshmen were required to reflect on their individual growth as a learner, revealed that many freshmen were grateful to have learned the skills and strategies taught in the MSI and extended these skills to other courses they were enrolled in during their initial term at BYU. The directors of FA found the success of the MSI to be positive upon the students receiving the instruction, therefore, this instruction was taught again during the Winter 2008 semester and in the Summer 2008 term (prior to this study being conducted) with a smaller and more general population.

#### *Metacognitive Reflection Assignments*

The second independent variable utilized in this study was a weekly metacognitive reflection assignment (shown in Appendix C). This assignment was given to students (in Group 3 only) who received the MSI instruction during the second week of their University 101 Freshman Seminar class. These students were asked to report what steps they engaged in while planning, monitoring, regulating, and evaluating their efforts to complete assignments required of them over the term. These assignments encouraged students to continue thinking about metacognition and explicitly engage in the steps of metacognition as they proceeded through the term.

## Procedure

The MAI was administered as a pretest to all participating students during the second week of class in all six University 101 classes of the Social Sciences learning communities to control for possible differences as supported by Muchlinski (1994).

At the beginning of the training, each student in the study was provided with an informed consent form (see Appendix E) as required by the Institutional Review Board of BYU. After all consent forms were signed, students then responded to the MAI questionnaire. Peer mentors then taught the MSI to four of the six University 101 classes (known as Group 2 and Group 3) in a university classroom setting as a normal part of course instruction outlined in the syllabus and using the PowerPoint in Appendix D. Since the remaining two University 101 classes (Group 1) were considered to be a comparison group, they did not receive this instruction but instead received instruction on thinking skills.

Although some may have a concern that the use of multiple instructors to teach the MSI could lead to a weakened study, Campbell and Stanley (1963) report “there is a strength to using different teachers to teach the item under question to their students in that the specific irrelevancies are not apt to be repeated each time” (p. 202) as may be seen when the instruction is taped and shown repeatedly, thus passing from one session to another any irrelevant features contained within the taped training. At the same time, equivalency of this instruction was achieved at one level in that all classes receiving the instruction were supplied with identical PowerPoint presentations of the MSI instruction and the specific steps and strategies contained therein, as well as a student handout (shown in Appendix F) of the same MSI steps and strategies.

The MSI instruction began with an overall description and explanation of the concept of metacognition and how it relates to possible academic success in students. After the introductory discussion, the four main steps of the MSI, along with suggested questions for students to ask themselves contained within each step, were viewed and discussed. The students were then given the assignment to read and analyze their Fall 2008 syllabus for the University 101 course, using the MSI as a guide, and then transferring due dates and other time sensitive information from the syllabi of all of their Fall 2008 semester courses to their personal planner or other time management system. This assignment (see Appendix G) focused students on understanding, planning, and initiating steps to undertake the various assignments and learning projects that are required of them in all courses during their first semester as university students.

Students then showed their completed work to their peer mentor at the next meeting of their University 101 class. Students were given the opportunity at that time to discuss their attempts at working through the assignment and had the opportunity to then learn from each other as they discussed different approaches, strategies, strengths, and weakness encountered, as supported by Kirkwood (2000), Matanzo and Harris (1999), and McCormick (2006). The intent of having the students work through the assignment individually was to provide the students with the opportunity to first, privately, identify their own metacognitive strengths and weakness. After receiving the initial MSI instruction and completing this first assignment, students then were instructed to proceed through the normal course, completing assignments and exercises as required.

During the term, students in Group 3 ( $n = 77$ ) were given a weekly metacognitive reflection assignment in which they were asked to specifically reflect on their use of the metacognitive skills and strategies taught them in the MSI as it was applied to an assignment or

other learning experience encountered during the week. Neither Group 2, which also received the MSI training, nor Group 1, which did not received the MSI training, were given this weekly metacognitive reflection assignment. The idea here was that students in Group 3 would not only try to complete the assignments required of them, but also explicitly reflect on their thinking and strategizing, as well as any back tracking or debugging they engaged in as they mentally worked through their assignments. This approach encouraged reflective thinking and may have been difficult initially since reflection is not an automatic process, is seldom required of students prior to entering college, and may rarely be required of students during college. The researcher was specifically looking for the following evidence of planning, monitoring, regulating, and evaluating in the students' reflective responses:

1. Steps taken to identify and use resources with specific learning purposes in mind
2. Descriptions written of students thinking ahead to anticipate potential problems
3. Descriptions written of appropriate actions taken to avoid problems
4. Increased usage of resources and approaches to an assigned task
5. Increased evidence of students picking up on their own errors
6. After-the-fact methods of attack for debugging their work

Articles written by Cooper (2004), Harrison et al. (2003), Kirkwood (2000), Kuiper and Pesut (2004), and Wilburne (1997), report that applying the criteria above to the students' responses provides evidence of the metacognitive skills of planning, monitoring, regulating, and evaluating.

At the end of the semester all students were, again, asked to complete the MAI, this time in a posttest and retrospective pretest manner, with both questionnaires being administered simultaneously during the last period of their University 101 class. Students were asked to gauge

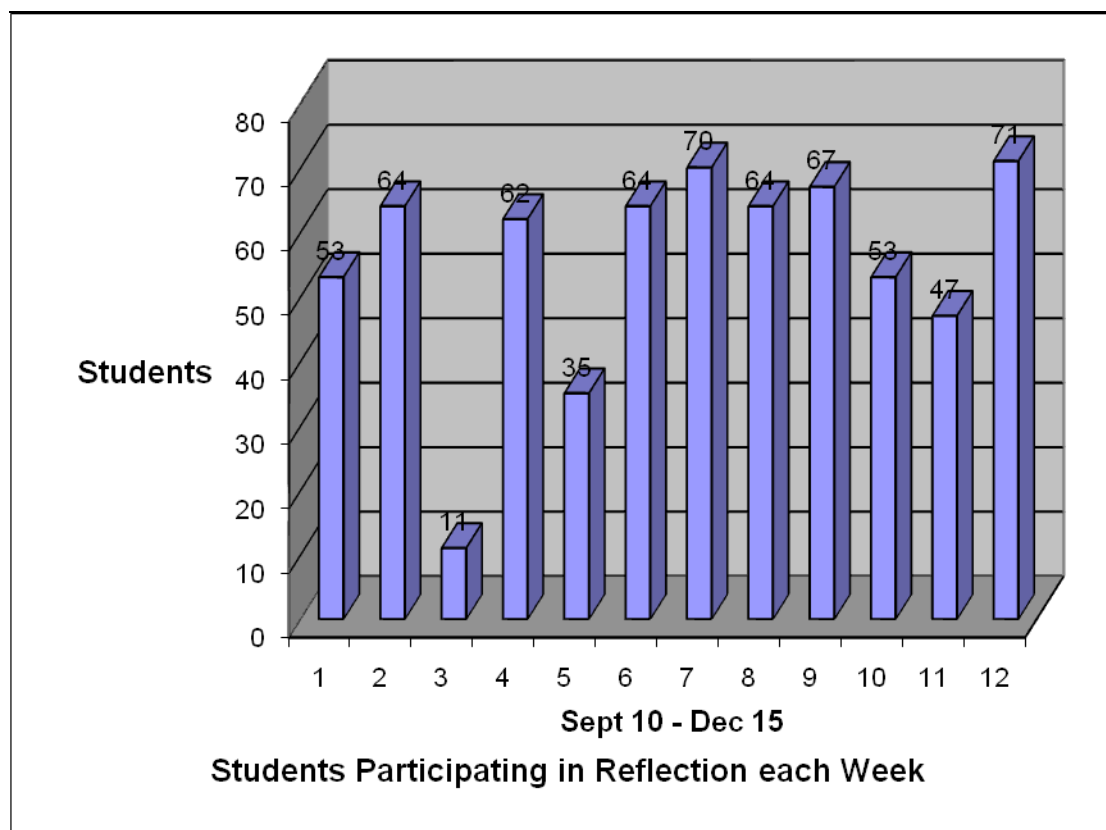
their awareness and usage of metacognitive skills and strategies as they now understood them (posttest) and then to go back through the questionnaire and gauge their use of metacognition prior to receiving metacognitive skill instruction (retrospective pretest).

Taking the MAI again, retrospectively at the end of the term, not only allowed the students a first-hand opportunity to assess their metacognitive awareness and usage of the information contained within the MSI prior to receiving the training, but also allowed the researcher to assess student metacognitive awareness and usage between those students who received the MSI instruction and those who did not, as well as gauge any increase in metacognitive usage between those students specifically prompted to engage in the metacognitive reflective assignments during the course and those students not so prompted.

To track classroom implementation of the procedures outlined above a number of steps were taken to ensure compliance. First, the researcher taught the MSI to a group of peer mentors in the pilot test of this study. Several of the peer mentors in this group then taught the MSI to all FA peer mentors during a peer mentor Fall Training session. The researcher attended this larger peer mentor training session to ensure that the MSI was being taught properly to all peer mentors in attendance. By attending this training the researcher had the opportunity to answer any questions that arose from this training. Second, the researcher interviewed each peer mentor who taught the MSI in their University 101 classroom to gain feed-back and final reactions to actually teaching the MSI to students. Of the peer mentors who responded to the researchers request for feedback, they reported that they had taught the MSI as a team with another peer mentor and took 15-20 minutes at the beginning of the class period to teach the MSI using the PowerPoint provided. Third, the professor teaching the two classes that make up Group 3 as well as the researcher monitored incoming student metacognitive reflections on a weekly basis over the

course of the term to ensure that students in Group 3 were engaging in the reflection process.

Figure 1 depicts the number of students who engaged each week in these weekly metacognitive reflection assignments.



*Figure 1.* Number of students participating in weekly metacognitive reflection assignments out of a total of 77 students

Initially, the reflections received by the researcher were strong in number but as assignments for classes came due and study for tests took first priority, responses to the metacognitive reflection assignments dropped drastically (to less than 40% response rate). As can be seen, weeks 3 and 5 had very few metacognitive reflection assignments turned in. Not only did the number of reflections drop off drastically, but the depth of articulation also dipped as students were faced with a number of tests and getting ready for first mid-term exams. Upon



noticing this trend, the researcher e-mailed the professor of Group 3 asking for assistance in getting students to start responding to the metacognitive reflection assignments.

It was not until the sixth week of the term that reflection responses increased in number and stayed solid until the Thanksgiving holiday (week 10). Students report that prior to and right after this holiday they were overwhelmed with tests, papers, assignments, and projects due in various classes. This may account for the drop in response to the metacognitive reflection assignments towards the end of the term.

Fourth, at the end of the term the researcher conversed with the professors of Groups 2 and 3 in an effort to ascertain their perceptions about engaging with metacognition over the term and how they viewed, from a teacher's standpoint, their students' responses to the teaching.

The professor of Group 2 commented that she did not believe that her students used metacognition after being exposed to the material in the MSI only once. The professor of Group 3 reported that she believed that managing the prompt, encouraging student participation, and responding to their reflections of their use of metacognition took an enormous amount of time in relationship to the advancement of students thinking and metacognitive skills. She offered a future solution of having the students reflect weekly up to and through the first mid-term exams and then having students reflect bi-weekly or once every three weeks after that, thus lessening the burden on students as well as staff.

### Statistical Analysis

In an effort to statistically examine the data, evidence of increased awareness and usage of metacognition was examined from three different vantage points. First, a one-way analysis of variance (ANOVA) was used to test Hypothesis 1 to detect any initial mean differences between students in the three groups on the MAI pretest. Second, evidence of students' increased use of

metacognition from posttest to retrospective pretest was assessed using a 3 (group) by 2 (test occasion) repeated measures univariate (ANOVA). Third, planned contrasts were used to test Hypotheses 2 and 3. The first of those two tests was a complex contrast comparing the average of the means of the two treatment groups (Groups 2 and 3) versus the mean of the control group (Group 1). The coefficients used to construct this contrast were -1, +.5, and +.5. Hypothesis 3 compared the means of the two treatment groups. This hypothesis was tested using the contrast coefficients 0, -1, and +1 for Groups 1, 2, and 3 respectively.

The researcher also conducted an exploratory factor analysis (EFA) on the eight subscales contained within the MAI in an effort to ascertain if the MAI is, in fact, a two factor, eight sub-scale model as the developers claim it to be.

As with most studies, there were issues with missing data. The researcher found that occasionally a student would omit an item when responding to the MAI. Whether this omission was intentional or accidental is not known. In order to more closely determine what value the missing data might have reflected, the researcher determined to replace any missing data from a student's responses to the MAI with the individual's average response to the other items in that subscale. For instance, if a student in Group 1 did not answer MAI question 5, the researcher calculated the mean score for that individual's answers to the other items contained within the declarative knowledge subscale (which includes MAI question 5) and inserted that mean into the missing data slot. By using this method, the researcher attempted to insure that a student's missing answer most closely mirrored the answers that student reported within that specific variable as described by McKnight (2007, p. 133). This method was used on less than 0.07% of the data and is not considered a major hindrance to the results of this study. All data collected in this study were analyzed using SPSS with a significance level set at .05.

## CHAPTER 4: RESULTS

This chapter describes the effects of the metacognitive instruction as evidenced by the responses of the three groups of freshmen on the MAI. The first section presents estimates of the reliability of the eight subscales proposed by the developers of the MAI. The second section reports the results of an exploratory factor analysis of the students' responses to the MAI. The third section describes similarities in the means and standard deviations of the three groups on each testing occasion. The fourth section contrasts responses of the three groups on the posttest and the retrospective pretest. The final section presents the data examined in the three research hypotheses and the results of each hypothesis test.

### Reliability of MAI Subscale Scores

Coefficient alpha reliability estimates for each of the eight MAI subscales proposed by the developers are presented in Table 4. The reliability coefficients are generally low with very few of them exceeding .70. The pretest reliability estimates range from a low of .47 to a high of .67. Retrospective pretest reliability estimates are a bit higher and range from a low of .58 to a high of .75 while posttest reliability estimates are almost equivalent to the retrospective pretest coefficients (low of .58 to a high of .73). The Conditional Knowledge subscale consistently had the lowest reliability coefficients across the three testing occasions while the Information Management subscale consistently had the highest coefficients. This finding is not surprising since the Information Management subscale consisted of ten items and the Conditional Knowledge subscale consists of only five items. The low reliability of the MAI subscale scores is a matter of concern in light of the fact that the MAI is a widely used measure in educational settings.

Table 4

*Estimated Reliability Coefficients for Each MAI Subscale by Test Occasion*

Variable	Corresponding MAI Items	Number of Items	Alpha Coefficients		
			Pretest	Retro-Pre	Posttest
Declarative Knowledge	5, 10, 12, 16, 17, 20, 32, 46	8	.62	.72	.67
Procedural Knowledge	3, 14, 27, 33	4	.62	.64	.59
Conditional Knowledge	15, 18, 26, 29, 35	5	.47	.58	.58
Planning Strategies	4, 6, 8, 22, 23, 42, 45	7	.58	.65	.62
Information Management	9, 13, 30, 31, 37, 39, 41, 43, 47, 48	10	.67	.75	.73
Comprehension Monitoring	1, 2, 11, 21, 28, 34, 49	7	.60	.70	.68
Debugging Strategies	25, 40, 44, 51, 52	5	.58	.65	.61
Evaluation	7, 19, 24, 36, 38, 50	6	.60	.64	.68
Composite		52	.90	.93	.93

## Exploratory Factor Analysis of the MAI

In an effort to further verify the proposed factor structure of the MAI an exploratory factor analysis (EFA) was conducted using the students' scores on the eight subscale scores as the input data. The results of this analysis are described here.

In this analysis no restrictions were placed on the number of factors to be retained. The absolute size of the eigenvalues for the eight factors initially extracted is reported in Table 5. The results in Table 5 indicate that the first factor had an eigenvalue that was more than 6.9 times larger than the second factor. This first factor dominates all the others and accounts for 62 percent of the total variance. Figure 2 is a scree plot that graphically displays the relative size of the eight eigenvalues. Interpretation of the scree plot suggests the possible existence of a weak second factor, but the absolute size of the eigenvalue for this second factor is considerably less

Table 5

*Results of Exploratory Factor Analysis on MAI Subscales*

Factor	Initial Eigenvalues		
	Total	Percentage of Variance	Cumulative Percentage
1	4.98	62.23	62.23
2	0.72	9.01	71.24
3	0.51	6.33	77.58
4	0.48	6.01	83.59
5	0.43	5.36	88.95
6	0.33	4.15	93.10
7	0.29	3.62	96.71
8	0.26	3.30	100.00

than 1.0 and the results of a Promax rotation indicated that the two factors were correlated at .788. Based on these results, the researcher concluded that the MAI scores measure one factor. The researcher labeled this single factor as *global metacognition*. The global metacognition means and standard deviations for each of the three groups on the MAI pretest are displayed in Table 6. The pretest results indicate that at the beginning of the semester

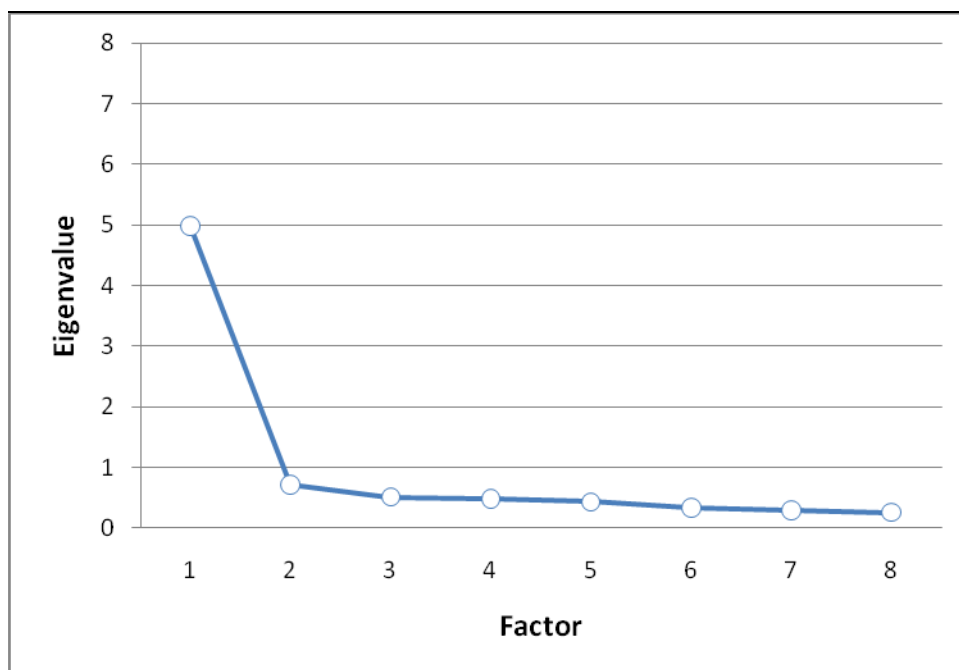


Figure 2. Scree plot of exploratory factor analysis on MAI subscales

#### Group Differences on the MAI

there was a very small difference between group means (.04 or less). The standard deviations for the three groups are even more similar.

Table 6

#### *Global Metacognitive Mean Scores on Pretest MAI*

Group	Sample Size	Mean	Standard Deviation
1	71	3.62	.36
2	78	3.66	.35
3	78	3.64	.35

The resultant  $F$  ratio of a one-way ANOVA was .29 and the significance level was .75 indicating that the difference between the three group means prior to implementing the MSI treatment was not statistically significant. This finding supports the conclusion that the three

groups were essentially equivalent in terms of their metacognitive awareness at the beginning of the study.

The researcher was unable to match the pretest scores to the posttest or retrospective pretest scores because the students were not asked to record their names on the pretest when they responded to it initially during the second week of class. Consequently, it was not possible to include the pretest MAI measures in the repeated measures analysis that was used to compare students' responses on the posttest and retrospective pretest.

### Repeated Measure Analysis

#### *Research Hypothesis 1*

The first research hypothesis stated that the combined mean of all three groups on the MAI posttest will be significantly greater than the combined mean of all three groups' response to the retrospective pretest. Table 7 displays the group means and standard deviations for the three groups on the retrospective pretest and the posttest. It should be noted that a relatively small number of students were dropped from this portion of the study due to not answering the retrospective pretest and/or posttest items on the MAI. Group 1 lost three students due to this problem (resultant  $n = 68$ ), Group 2 had seven students dropped for not fully answering the MAI questionnaire (resultant  $n = 71$ ), and Group 3 lost six students (resultant  $n = 72$ ) due to the same lack of response.

The combined mean of all three groups on the retrospective pretest was 3.27 while the combined mean for the groups was 3.96 on the posttest. A repeated measures univariate

Table 7

*Mean Scores on the MAI Posttest and Retrospective Pretest*

Group	N	Retrospective Pretest		Posttest		Mean Difference
		Mean	SD	Mean	SD	
1	68	3.30	.46	3.95	.39	.65
2	71	3.23	.49	3.93	.41	.70
3	72	3.30	.46	4.01	.36	.71
Combined	211	3.27		3.96		.68

ANOVA using the multivariate option in the General Linear Model procedure in SPSS 16.0 was conducted to test the hypothesis of whether the difference in these two means was statistically significant. The results are reported in the Test Occasion line of Table 8 and indicate that this mean difference was significant ( $p < .0001$ ). The Group by Test Occasion interaction was not significant. This indicates that the population means for the three groups maintained the same order on the posttest as on the retrospective pretest. The difference in the combined mean of the three groups averaged across the two test occasions was not statistically significant as indicated by the Between Groups line in Table 9.

Table 8

*Global Tests of Multivariate Effects*

Effect	Wilks' Lambda	F-Test	Degrees of Freedom		Probability
			Hypothesis	Error	
Within Subjects					
Test Occasion	0.351	384.610	1	208	.0001
Group by Test Occasion	0.999	.114	2	20	.892



Table 9

*Tests of Between-Subjects Effects*

Source of Variability	Type III Sum of Squares	Degrees of Freedom	Mean Square	F-ratio	Probability
Between Groups	0.523	2	0.261	1.114	.330
Error	48.803	208	0.235		

*Research Hypothesis 2*

The second research hypothesis asserted that freshmen who receive direct metacognitive instruction (Groups 2 and 3) will receive higher posttest mean scores on the MAI than freshmen who do not receive such instruction (Group 1). The posttest means of the three groups are presented in Table 7 and show that students reported posttest mean score averages between 3.93 and 4.01. Students in Group 3, who specifically reflected on their use of metacognition over the term, appeared to rate themselves slightly higher on the average on the posttest than the other groups.

Hypothesis 2 was tested by using a planned single degree of freedom contrast. This contrast was formed by averaging the means of Groups 2 and 3 and then subtracting this average from the mean of Group 1 using the contrast coefficients -1, +.5, and +.5 as weights for Groups 1, 2, and 3 respectively. The data in the first row of Table 10 shows that the observed difference between the control group and the average of the two treatment groups was not statistically significant.

*Research Hypothesis 3*

The third research hypothesis stated that students who reflected weekly on their metacognitive usage (Group 3) would receive higher posttest mean scores on the MAI than

students who were taught the MSI but not required to reflect on their usage of these skills (Group 2).

Table 10

*Results of Multivariate Analysis of Variance Contrast*

Contrast	Estimated Differences	Standard Error	Probability
Group 1 versus Groups 2 & 3	-.050	.050	.918
Group 2 versus Group 3	-.085	.057	.138

The means and standard deviations needed to test this hypothesis were already reported in Table 7.

Hypothesis 3 was also tested by using a planned single degree of freedom contrast. This contrast was formed by subtracting the mean of Group 2 from the mean of Group 3 using the contrast coefficients -1 and +1 as weights for Groups 2 and 3 respectively. The results of this hypothesis test are reported in the second row of Table 10. Note that no significant difference was found between Groups 2 and 3. Therefore, the null hypothesis was not rejected.

*Effect of Administering the Posttest and Retrospective Pretest Together*

An additional analysis was conducted to determine if students in all three groups were able to make the psychological shift needed to successfully rate their knowledge and usage of metacognition (posttest) compared to how they recall it when both measures are taken simultaneously. This last administration of the MAI required students to complete the MAI questionnaire with blank spaces for posttest answers to be recorded on the left hand side of the page and blank spaces for their retrospective answers to be recorded on the right hand side of the page (see Appendix B). The students were instructed to rate their understanding and use of

metacognition at the time this assessment was administered and then read each of the items again and rate themselves retrospectively in terms of their knowledge and use of metacognitive strategies before the course. Consequently, the time lag between taking the posttest and the retrospective pretest was only a matter of a few minutes.

To investigate this issue, students' scores on the original eight MAI subscales were submitted to a confirmatory factor analysis (CFA) using AMOS software. The model that was analyzed is depicted in Figure 3. The students' responses to the MAI posttest were modeled as one factor and their subsequent responses to the retrospective pretest were modeled as a second factor as indicated by the single, double-headed arrow on the left side of Figure 3 that connects the ellipses representing the posttest with the retrospective pretest. These two factors were assumed to be correlated. Similarly, as indicated by the series of curved, double-headed arrows on the right side of Figure 3, the error terms for corresponding subscales on the posttest and retrospective pretest were freely estimated to determine to what extent these measurement errors were correlated. To the extent that the students had rated themselves on the retrospective pretest independently of the way in which they rated themselves on the posttest, the estimated correlation coefficient for each of these linked estimates would be near zero and statistically nonsignificant. The resulting parameter estimates are reported in Figure 3. The Chi Square fit statistics for this model are  $\chi^2 = 544.988$  with 103 degrees of freedom. The Comparative Fit Index was .961 and the Root Mean Square Error of Approximation (RMSEA) was .068. The lower limit of the 90 percent confidence interval for the RMSEA was .054 and the upper limit was .082. Considered together these results are indicative of good fit. The numerical values adjacent to the curved, double-headed arrows shown in Figure 3 are correlation coefficients. The correlation between the posttest factor and the retrospective factor was .29. This interfactor

correlation of .29 is above and beyond the amount of association accounted for by the correlated errors. The correlated error terms ranged in magnitude from .31 to .56 and all eight of them were statistically significant.

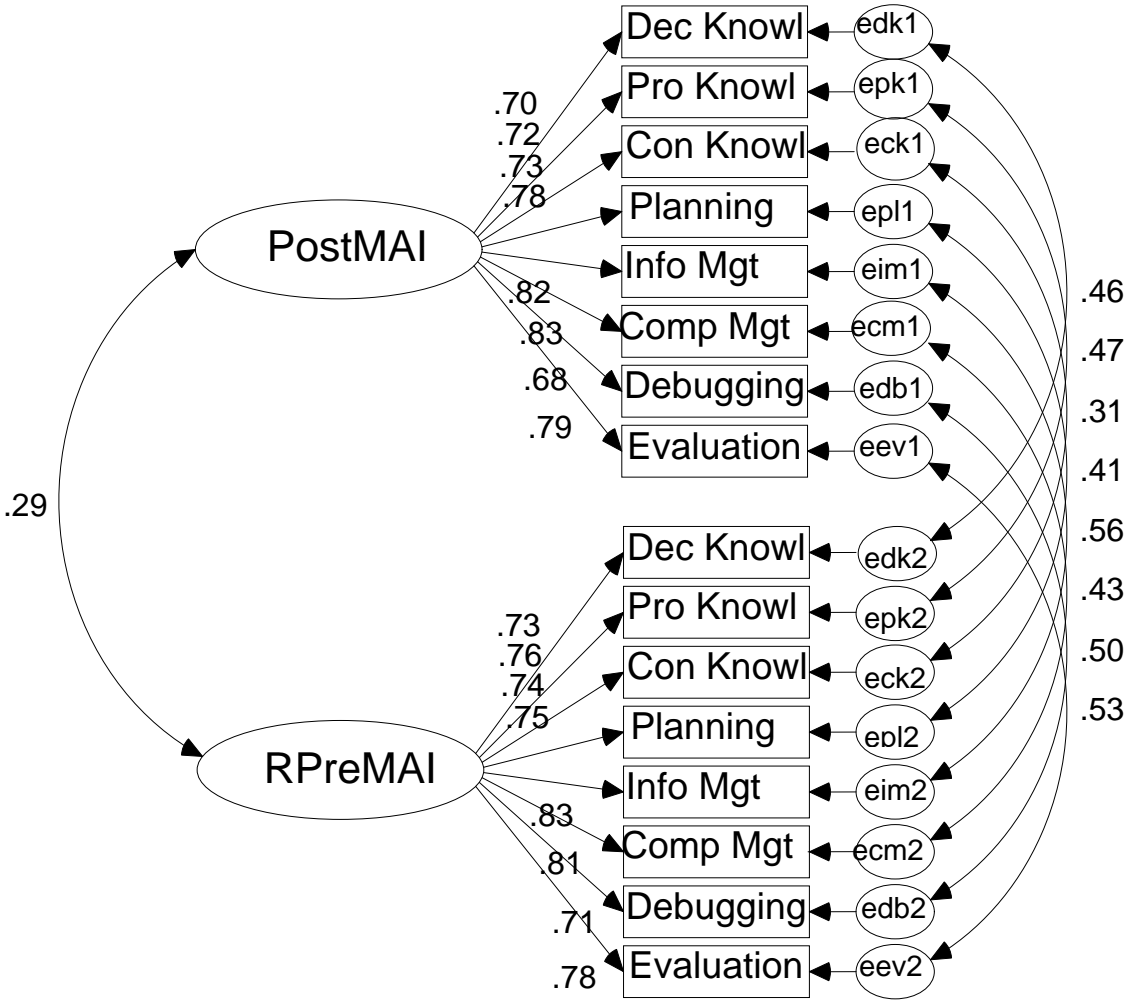


Figure 3. Correlated errors between corresponding variables on the MAI posttest and retrospective pretest

These findings indicate that the students' answers to the questions on the retrospective pretest were not independent of their answers to corresponding questions on the posttest.

## CHAPTER 5: DISCUSSION

### Pre-Treatment Differences between Groups

Analysis of students' response to the initial MAI pretest collected during the second week of the term indicated that there was no difference between the three group means. The initial responses indicated that these freshmen usually did not develop a plan for studying a particular assignment. Instead, the students reported that they tended to simply start the assignment, using surface level strategies (i.e., re-reading information, slowing down when they encountered new information, or asking others for help) regardless of subject matter or technical diversity of the task at hand. The students also reported that they did not approach academic assignments at a deeper level that would include (a) asking themselves questions about the material before they began, (b) connecting new material to already learned material, (c) looking at how the subject matter in one class connects to the subject matter in another class, (d) translating content matter into their own words, or (e) seeking out new learning strategies that may enhance their learning and retention as supported by Harrison et al. (2003).

Students also reported that they did not analyze the usefulness of their study strategies. Therefore, inefficient or ineffective strategies may not have been recognized or abandoned in the quest of a more appropriate solution. The students appeared to place a heavy emphasis on correcting mistakes that might not have occurred if they had put more initial thought and planning into their approach and the desired outcome of assignments as opposed to simply plunging in and hoping for the best. These findings are similar to and consistent with findings previously reported by Cooper (2004), Kirkwood (2000), and Leamnson (1999).

One interesting element noticed in the freshmen's pretest responses was that they preferred to be taught subjects that they were familiar with and interested in as opposed to

subjects that were unfamiliar and challenged them to expand their knowledge into areas that they did not see as relevant at this stage of their learning. This is an interesting finding when one considers that students report in their reflections that one of the main purposes of attending college was to find areas of interest to focus on for future careers. However, one is not likely to find new areas of interest without exposing oneself to new and challenging subjects or information.

## Findings

### *Research Hypothesis 1*

The first research hypothesis asserted that the combined mean of all three groups on the MAI posttest would be significantly greater than the combined mean of all three groups' responses to the retrospective pretest. The results of the ANOVA indicated that this increase was achieved. The test of within-subjects analysis indicated that all groups experienced significant gains from the retrospective pretest to posttest on the MAI including Group 1 who did not receive the MSI training.

There are a number of possible reasons for this finding. The first being that the University 101 program normally encourages students to “pay consistent attention to personal progress, i.e., self-monitoring, or self-regulation by promoting student reflection, offering student development courses, and encouraging students to try multiple learning strategies” as stated on the FA website (retrieved from FA website, June 1, 2007). Thus, the students who received the critical thinking instruction, which is a normal part of University 101 (Group 1), might have understood and answered the questions contained within the MAI from the vantage point of this critical thinking instruction.

Another possible reason could be that the retrospective pretest and the posttest were administered simultaneously with current levels (posttest) of metacognition being rated on the left side of the page and retrospective levels of metacognition being rated on the right side of the same page. Since much occurred in the life of these students during this first term on a University campus it may well be that they were unable to clearly remember their level or usage of learning skills prior to arriving at the university. Or, taking both the posttest and the pretest so close together with the posttest being taken first may have influenced students' responses to the retrospective pretest. Allen et al. (2007), Campbell and Stanley (1963), and Elmes et al. (1992) all contend that it may be difficult to get completely accurate information from students on retrospective pretests due to forgetting. They also claim that participants may distort their memories to match their current beliefs or what they have come to believe to be a socially desirable response.

A third possible reason for this observed gain is that the retrospective pretest and posttest were administered on the last day of class which was not a normal day of instruction but instead was held in a large auditorium wherein students were instructed to dress in business attire in order to present their final poster projects. This was a somewhat intense form of University 101's final and the MAI with its retrospective pretest and posttest was a part of this last culminating project. While administering the MAI in this setting tended to guarantee student response, this may have lead the students in all three groups to simply mark an item on the MAI without taking the time to really think back and accurately recall their learning skills prior to entering University 101 or student response may actually be more a reflection of student's perception of metacognition rather than their actual use of metacognition in educational tasks.

### *Research Hypothesis 2*

The second research hypothesis asserted that freshmen who received direct metacognitive instruction (Groups 2 and 3) would earn higher posttest mean scores on the MAI than freshmen who did not receive such instruction (Group1). Students in Group 3 had slightly higher posttest mean scores than those students in Group 1. However, this same finding is not present when observing mean scores between Groups 2 and 1. Group 2, who received the MSI instruction but did not reflect, did not appear to rate themselves higher on the posttest than did students in Group 1.

This result reflects that for entering university freshmen simple exposure to the MSI with minimal initial instruction in metacognition at the beginning of their experience at the university may not be enough to change freshmen students' use of metacognition. For such instruction to really be of value and be of use to students it may be that the students must actually use the skills contained in the instruction, grappling with it over time in a variety of applications. The fact that students in Group 1 appeared to rate themselves higher on the MAI posttest than students in Group 2 is in line with the findings of Allen et al. (2007). They reported that those students who are unaware of what they do not know tend to rate themselves higher on their academic abilities because of their lack of information regarding what they do not know.

### *Research Hypothesis 3*

The third research hypothesis stated that students who reflected weekly on their metacognitive usage (Group 3) would receive higher posttest mean scores on the MAI than students who were taught the MSI but were not required to reflect on their use of these skills (Group 2). Comparisons of students' ratings on the MAI posttest showed that students in Group 3 rated themselves slightly higher on all of the purported MAI subscales. The higher increase in



mean scores produced by Group 3 were found to be significant on two purported MAI subscales (Declarative Knowledge  $p = .046$  and Planning Strategies  $p = .020$ ).

This finding lends further support to the argument that there is value in bringing metacognition to the immediate attention of university students, asking them to actively use it on a variety of topics, and then requiring them to reflect on their successes and/or failures around its use. Many times students' responses to the weekly metacognitive reflection assignments indicated that students considered themselves more equipped, confident, and less stressed after using the steps and strategies contained within the MSI. One student remarked that "Consciously thinking about my thinking made my studying more effective. I was more focused with a goal in mind and was motivated to put in the work in order to gain clear understanding."

A second student expressed his thoughts.

While reading my textbooks I would pause to reflect on my concentration or effectiveness in learning. If I found myself straying I exercised newly learned skills. I realize it will take some practice for me to get accustomed to metacognition, but I can already see its benefits.

These responses are similar to those uncovered by Dearnley and Matthew (2007), Hartman (2001), and McAlpine et al. (1999). They argue that the students in their studies experienced an increase in self-esteem, self-awareness, and confidence once taught to use the skills and strategies of metacognition and that for these students' ineffective approaches to learning, feelings of failure, and unrealistic expectations in regards to higher education diminished.

Although the effect of reflection was not formally tested in this study, it should be noted on a general level that the students reported that they were eagerly and openly searching for other ways they could learn the various information they were presented within their individual classes

as the MSI supports. This indicates that the ineffective study strategies this population is reported to bring with them to their first year in a university setting may be slowly giving way to a deeper quest to truly learn that mirrors that of an expert which is consistent with the findings previously reported by Cooper (2004), Kirkwood (2000), and Leamson (1999). However, it should be noted that this level of instruction is not likely to create this type of outcome unless the instruction is intense and sustained over time.

None of the students expressed a negative response to using metacognition or reflecting on that usage which is counter to the findings of Jing (2006). There were times when students reported that they were overwhelmed with projects, papers, tests, and other assignments all due at the same time and therefore, did not consciously monitor or evaluate their thinking, leaving them with nothing to report. This occasional lack of response to the reflection assignment shows that students do place a cost-benefit analysis of sorts, as reported by Dearnley and Matthew (2007), on the demands made of them during their academic career. Consequently, those assignments that were judged to not be major or crucial were the first to be laid to the side so that time and effort could be focused on what students judged to be more pressing. Unfortunately, at times, the weekly metacognitive reflection assignments apparently became a victim of this cost-benefit weighing.

One uplifting element of the reflective responses was that students indicated that they utilized the metacognitive skills and strategies they had been taught for other non-academic areas of their lives. Students reported identifying a problem, planning how to overcome that problem, monitoring their strategy, and drawing conclusions as to how their approach worked (evaluation) for a variety of topics such as family problems, friendship problems, church callings, devotion to religious matters, sports performance, grocery shopping on a very tight budget, and planning fun

events, to name just a few. This branching out to employ metacognitive strategies in non-academic areas shows that students were able to connect and use the skills and strategies they had been taught in other contexts which is what Dearnley and Matthew (2007), Harrison et al. (2003), and McAlpine et al. (1999) claim to be the ultimate aim of teaching such skills.

One aspect of this study reflected the findings of Jing (2006) who wrote that teaching metacognition was difficult and time consuming for the instructor. Although the act of teaching metacognition may not have been a burden to the professors in this study (as metacognition was taught by FA peer mentors), the professor of Group 3 did report that reminding students to reflect and then responding to those reflections every week involved a lot of work. She also reported that students grasped metacognition at different stages with some getting it right away while others did not get it until towards the end of the semester, if at all.

Increased time demands placed on this professor were self-evident in that she personally responded back to her students' reflections with encouragement or direction over the course of the term, significantly increasing the workload for this professor.

The professor who taught Group 2 declared that she believed that her students did not understand metacognition at all and both professors believed that students need to reflect on their metacognition, even weekly at first, to get into the habit of bringing their thoughts to the forefront of their consciousness where those thoughts could be consciously evaluated. However, to avoid student burnout constant, explicit reflection needed to be required less often (possibly every second or third week) for the rest of term.

Various students reported that they felt they were more responsible and accountable for their learning by engaging in the weekly metacognitive reflection assignment. This finding is consistent with the findings of Kuiper and Pesut (2004) as well as McAlpine et al. (1999) who

report that having students regularly reflect integrated theory with practice and enhanced students' connection with the learning process. The intellectual tugging and pulling between what worked and what did not was witnessed in many students' reflections as they tried to find their style and what worked best for them in terms of (a) managing time, (b) approaching an assignment, (c) monitoring that approach, (d) abandoning strategies that were not getting them where they believed they needed to go, and (e) then struggling to find a different way that would work for them. A very strategic component of this mental tugging and pulling is exemplified in the following example.

The biggest task before I left yesterday though was finishing my SFL paper. I did not feel as prepared as I should have. I started out by mapping out what I would write about, and mapping out my time to work on my paper. I then set smaller goals within the planning and then after I finished a paragraph or a section of my paper I was able to go back and re-evaluate my work. Through this constant re-evaluation I was able to write to my best ability with more confidence than I had before.

This closely mirrors Wilburne's (1997) comments that the most significant change she witnessed in her students was an increase in their self-perceptions of their own abilities. These increased beliefs in self translated into action, wherein students were more willing to invest additional effort, to persist without giving up, and to seek further resources in completing academic assignments.

Asking students to complete the MAI both as a posttest and a retrospective pretest on the same occasion with instructions to answer the posttest first and then go back and read through each question and answer them retrospectively with both posttest and retrospective pretest appearing on the same page did not prove to be an effective approach. Students could readily

view what they had marked as their answer to the posttest and this may have influenced how they responded, retrospectively, to the same questions.

Although asking participants of a study to think back and recall past behavior has value as supported by the plethora of published articles that report their use, administering both the posttest and the retrospective pretest on the same day, at the same time, and on the same page, with answers to both visible to students, was not an effective approach.

### Limitations

There were several limitations to this study. The first limitation was the researcher's inability to match pretest scores from the first administration of the MAI to the posttest and retrospective pretest.

The second limitation was administering the posttest and retrospective pretest simultaneously and on the same page. The retrospective pretest should have been administered separately from the posttest, possibly one week prior to the end of the term and then the posttest administered on the last day of class. Administering the MAI this way would allow the researcher to keep the answer sheet supplied by the developers in its original form and would not allow students to view what their previous answers had been.

### Recommendations

#### *Future Use of the MAI*

In the future, the MAI should be treated as one factor assessing global metacognition instead of breaking it down into the purported eight subscales that the developers claim exists. Due to the MAI only containing one dominant factor it is hypothesized that many items in the MAI can be deleted thereby shortening the measure. It is recommended that a follow-up

confirmatory factor analysis (CFA) be completed on the measure in an effort to further identify items to be retained or deleted.

#### *Further Research*

There are various ways to continue research on the MSI. One way would be to correlate participating students' final course grades with their MAI scores in an effort to further examine how usage of the skills taught in the MSI effects student grades.

Another approach to further the research would be to have students score their own MAI test (using the scoring table offered by the developers) after the initial testing occasion which would allow students to see for themselves what areas they were strong in and what areas they needed to improve in and then have these students metacognitively plan out (using the MSI as a guide) how to improve their weakest areas and report their efforts as they monitor, regulate, and evaluate their progress over a term.

#### *Improvement of the MSI*

Further refinement of the MSI is recommended. It would be of interest to hear teachers' and students' thoughts of how the tool could be refined. One way to accomplish this would be to have teachers and students, who have used the tool, give their input on the elements of each step that can be eliminated or condensed, as well as hear their input on the sequencing of steps and the elements within each step in an effort to further streamline the tool.

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## Appendix A

### Metacognitive Skill Instruction Model

## Metacognitive Skill Instruction

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### Behavior

### Actions

Behavior	Actions
<p style="text-align: center;"><b>Step 1</b></p> <p style="text-align: center;"><b>Identify the task at hand</b></p> <p>This step helps students identify the information they need to know to understand what the professor is asking them to do.</p> <p>Questions to ask yourself include:</p>	<ol style="list-style-type: none"> <li>1. What am I being asked to do? (Write a paper?) (Conduct an experiment?)</li> <li>2. What is the teacher asking me to learn? (Steps for a procedure?) (Historical content?)</li> <li>3. What do the instructions state are the objectives, goals, requirements of the assignment? (Highlight them) (Does a plan of action come to mind?)</li> <li>4. What were my first reactions when I read the problem? (Write them down)</li> <li>5. Do I already know something about this problem that I can use to help me get started?</li> <li>6. Do I understand all the terms/words in the assignment?</li> </ol>
<p style="text-align: center;"><b>Step 2</b></p> <p style="text-align: center;"><b>Determine an initial approach to the task</b></p> <p>This step helps students identify prior knowledge and learning strategies that may be helpful for the task at hand.</p> <p>Questions to ask yourself include:</p>	<ol style="list-style-type: none"> <li>1. Although I may already possess information and strategies that would work with this task, are there new ways of learning the teacher wants me to try?</li> <li>2. What other approaches could be used to solve this problem?</li> <li>3. Of the ideas that come to me, what information and strategies will be the most effective?</li> <li>4. What sequence should the process or approach take to get me to my end goal? (First A, then B, then C)</li> <li>5. How much time and effort will this problem require?</li> </ol>



<p style="text-align: center;"><b>Step 4</b></p> <p style="text-align: center;"><b>Evaluation</b></p> <p>Appraising your work, your performance, and your strategy effectiveness.</p> <p>Questions to ask yourself include:</p>	<ol style="list-style-type: none"><li>1. What do I think about the solution I reached?</li><li>2. What worked, what didn't, what would I do differently next time?</li><li>3. Did I find myself analyzing the usefulness of strategies while I studied?</li><li>4. Did I use my intellectual strengths to compensate for my weaknesses?</li><li>5. Did I learn as much as I could have/should have?</li><li>6. Are there any other options I should consider before I consider this task complete?</li></ol>
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## Appendix B

### Metacognitive Awareness Inventory

## Metacognitive Awareness Inventory (MAI)

(Schraw, G. and Dennison, R.S. - 1994)  
(Modified by permission of developer - Aug 17, 2007)

Please respond to the questions below by indicating how true or false each statement is about you. If a statement is always true, write the number 5 in the blank provided to the left of each statement. After answering all questions, go back a second time and respond to the questions as you would have responded before receiving metacognitive skill instruction, placing your answers to the right of each question. Your responses will remain anonymous so answer as truthfully as you can.

ALWAYS FALSE	SOMETIMES FALSE	NEUTRAL	SOMETIMES TRUE	ALWAYS TRUE
1	2	3	4	5

**Current level**

**Level before instruction**

- |       |                                                                           |       |
|-------|---------------------------------------------------------------------------|-------|
| _____ | 1. I ask myself periodically if I am meeting my goals.                    | _____ |
| _____ | 2. I consider several alternatives to a problem before I answer.          | _____ |
| _____ | 3. I try to use strategies that have worked in the past.                  | _____ |
| _____ | 4. I pace myself while learning in order to have enough time.             | _____ |
| _____ | 5. I understand my intellectual strengths and weaknesses.                 | _____ |
| _____ | 6. I think about what I really need to learn before I begin a task.       | _____ |
| _____ | 7. I know how well I did once I finish a test.                            | _____ |
| _____ | 8. I set specific goals before I begin a task.                            | _____ |
| _____ | 9. I slow down when I encounter important information.                    | _____ |
| _____ | 10. I know what kind of information is most important to learn.           | _____ |
| _____ | 11. I ask myself if I have considered all options when solving a problem. | _____ |
| _____ | 12. I am good at organizing information.                                  | _____ |
| _____ | 13. I consciously focus my attention on important information.            | _____ |
| _____ | 14. I have a specific purpose for each strategy I use.                    | _____ |
| _____ | 15. I learn best when I know something about the topic.                   | _____ |
| _____ | 16. I know what the teacher expects me to learn.                          | _____ |



### Metacognitive Awareness Inventory (MAI) Page 2

ALWAYS FALSE	SOMETIMES FALSE	NEUTRAL	SOMETIMES TRUE	ALWAYS TRUE
1	2	3	4	5

**Current level**

**Level before instruction**

- |       |                                                                                 |       |
|-------|---------------------------------------------------------------------------------|-------|
| _____ | 17. I am good at remembering information.                                       | _____ |
| _____ | 18. I use different learning strategies depending on the situation.             | _____ |
| _____ | 19. I ask myself if there was an easier way to do things after I finish a task. | _____ |
| _____ | 20. I have control over how well I learn.                                       | _____ |
| _____ | 21. I periodically review to help me understand important relationships.        | _____ |
| _____ | 22. I ask myself questions about the material before I begin.                   | _____ |
| _____ | 23. I think of several ways to solve a problem and choose the best one.         | _____ |
| _____ | 24. I summarize what I've learned after I finish.                               | _____ |
| _____ | 25. I ask others for help when I don't understand something.                    | _____ |
| _____ | 26. I can motivate myself to learn when I need to.                              | _____ |
| _____ | 27. I am aware of what strategies I use when I study.                           | _____ |
| _____ | 28. I find myself analyzing the usefulness of strategies while I study.         | _____ |
| _____ | 29. I use my intellectual strengths to compensate for my weaknesses.            | _____ |
| _____ | 30. I focus on the meaning and significance of new information.                 | _____ |
| _____ | 31. I create my own examples to make information more meaningful.               | _____ |
| _____ | 32. I am a good judge of how well I understand something.                       | _____ |
| _____ | 33. I find myself using helpful learning strategies automatically.              | _____ |
| _____ | 34. I find myself pausing regularly to check my comprehension.                  | _____ |
| _____ | 35. I know when each strategy I use will be most effective.                     | _____ |



## Appendix C

### Weekly Metacognitive Reflection Assignment

## Weekly Metacognitive Reflection Assignment

Using a metacognitive process (a process in which you think about your thinking) as you attempt to solve a problem, engage in an assignment, or complete a task can shorten the time it takes and help you be more successful. The metacognitive process invites you to do the following:

1. Begin by **Identifying** the problem, task, assignment.
2. Next **Determine** your initial approach (how you will start)
3. As you work, **Monitor** your progress and process.
4. When you think you are finished stop and **Evaluate** the product.

Posted in course materials is the PowerPoint we showed in class that provides questions to guide each step in the process if that will help you.

Please identify a time when you used or could have used metacognition during this week. Tell about the experience and comment on your understanding and how it impacted your work.

Appendix D

MSI PowerPoint as shown by Freshman Academy

## Metacognition: Thinking about Thinking

Are we supposed to do that???

## Metacognition Session: Learning Outcomes

- to apply the process or steps in metacognition to a task or assignment
- to create a picture of your student's first semester at BYU by using a course syllabus to discover learning outcomes, course demands, and expectations for one class your students are taking fall semester
- to connect expectations and course demands to a strategy for the wise use of time for the mentor and the students
- to evaluate implications for using metacognition in your role as a peer mentor

## Your assignment

- Actively participate in the presentation and discussion of metacognition, clarifying steps in the process as appropriate.
- Read, mark, and annotate a syllabus for one of the classes your students will be taking this fall to call attention to learning outcomes, important concepts, learning activities, and due dates. You can also mark those sections that are not clear to you or about which you have questions. This marking should be rich and detailed.
- Transfer assignment due dates and other time sensitive information from the syllabus to your planner. For example, it is a good idea to not only put in the final due date, but also important progress checks along the way (such as—assignment start dates, rough drafts, etc.), and potential time conflicts.
- Discuss with your assigned group, how you came to understand your student's experience this fall by using this process. *Make brief but significant comments after each question in the four-steps of the metacognitive process handout as you complete the assignment.*
- Discuss with your group, how understanding the student experience, can help you become an effective peer mentor this fall. How might students use their time wisely? How might this or a similar assignment help students?

## Metacognition goals

- Gain awareness of the importance of thinking about our thinking & how that affects our academic success / failure
- Come to understand our own personal way of thinking about and walking ourselves through assignments or tasks
- Learn how to regulate our thinking so we can be more successful
- Increase the skills that lead to becoming academically successful *such as:*
  - *identifying main task goals*
  - *monitoring our progress*
  - *questioning ourselves*
  - *assessing the end result*



## 4 Key Steps to Effective Metacognition

- Identify the task or assignment at hand
- Determine an initial approach to the task or assignment
- Monitor yourself as you work through the task or assignment
- Evaluate the finished work and your performance

### Step 1 – Identify the task or assignment at hand

This step helps students identify the information they need to know to understand what the professor is asking them to do.

#### Questions to ask yourself:

- What am “I” being asked to do in this assignment?
- What are the “staff” asking me to learn?
- What do the instructions state are the objectives, goals, requirements of the assignment?
- What were my first reactions when I read the assignment?
- Do I already know something about this problem (approaching a syllabus) that I can use to help me get started ?
- Do I understand all the words /terms in the assignment?



## Step 2 – Determine an initial approach to the task

This step helps students identify prior knowledge & learning strategies that might be helpful for the task at hand.

### Questions to ask yourself:

- Although I may already possess information and strategies from my past that would work with this task, what are additional strategies or new ways of learning Freshman Academy wants me to try?
- Of the ideas that come to me, what information and strategies will be the most effective?
- What sequence should the process or approach take? (First A, then B, then C)
- How much time and effort will this process or approach require?

## Step 3 – Monitoring yourself as you work through the task

This step has two major parts:

- The first part involves self-testing skills and strategies to process information more efficiently.
- The second part involves monitoring and correcting comprehension and performance errors which limit the effective solving of problems.

### Step 3-A—Information Management Strategies

This step helps students look for ways they can process information more efficiently.

#### Questions to ask yourself:

- Do I slow down and focus my attention on new or important information?
- Do I understand important relationships presented in the material?
- Do I create my own examples or draw pictures/diagrams to make information more meaningful? (i.e. Marking the syllabus or using the planner as a tool)
- Am I using how the information is organized in the syllabus, or presented by the teacher as a tool to help me learn?
- Do I need to re-evaluate my assumptions of the syllabus or course to better understand this assignment or material? (i.e. no homework, need to attend class)
- Do I have a deep enough understanding of the course to be able to summarize what I've learned after I'm finished? (if not, who can I ask for help?)

### Step 3-B—Comprehension Monitoring

Self-testing strategies used to monitor and correct comprehension and performance errors which limit the effective solving of problems.

#### Questions to ask yourself:

- What are my thoughts now as I am working through the assignment and syllabus?
- Am I clear on my understanding of what I am doing? Do I need to go back and re-read information that was not clear?
- Am I using relevant information effectively?
- Do I need to break the syllabus and assignments within the syllabus down into smaller steps to make them more manageable?
- Am I planning ahead to my next move or task requirement?
- Am I using my plan to understand this course and related assignments?
- Should this path I have chosen be abandoned and an alternative path be used instead? If so, is there anything that can be salvaged?



## Step 4—Evaluation

Appraising your work, your performance,  
and your strategy effectiveness.

### Questions to ask yourself:

- What do I think about the assumptions/conclusions/solution I reached?
- What worked /what didn't/what would I do differently next time?
- Did I find myself analyzing the usefulness of strategies while I studied?
- Did I use my intellectual strengths to compensate for my weaknesses?
- Did I learn as much as I could have/should have?
- Are there any other options I should consider before I consider this assignment or task complete?

## Metacognition Session: Learning Outcomes

- to help you create a picture of your student's first semester at BYU by using a course syllabus to discover learning outcomes, course demands, and expectations for one class your students are taking fall semester;
- to apply and practice the steps of metacognition; and
- to encourage you to use the process multiple times throughout the semester, (to complete the picture using other course syllabi, and to understand specific assignments for a class, etc.)

## Appendix E

### Participant Consent Form

## Metacognitive Skill Instruction: Consent to be a Research Subject

### **Introduction**

This research study is being conducted by Dana Erskine (4<sup>th</sup> yr PhD student) at Brigham Young University to determine if there is an increase in students' internal thinking and strategizing while engaged in academic tasks after receiving specific metacognitive skill instruction to increase these skills. You were selected to participate because you are currently a student in Freshman Academy.

### **Procedures**

You will be instructed in how to reflect and think more deeply about how you internally plan, monitor, and strategize while engaged in academic tasks. The instruction will last approximately 15 minutes and consist of in-depth explanation and modeling of skills. You will be given one short assignment to be completed on your own outside of class. At the end of the term you will be asked to complete a questionnaire regarding the training as part of your final exam. The questionnaire consists of 52 questions and will take approximately 15 minutes to complete. Questions will include details about how you plan, organize, and monitor your progress as you complete ordinary academic assignments.

### **Risks/Discomforts**

There are minimal risks for participation in this study. However, you may feel emotional discomfort when answering questions about personal strategies. The moderator will be sensitive to those who may become uncomfortable.

### **Benefits**

There are no direct benefits for participating in this study. However, it is hoped that through your participation you will learn more about how you internally reflect, plan, organize, prepare for, and monitor your progress as you complete academic assignments.

### **Confidentiality**

All information provided will remain confidential and will only be reported as group data with no identifying information. All data, including questionnaires from this study will be kept in a locked storage cabinet and only those directly involved with the research will have access to them. After the research is completed, the questionnaires will be destroyed.

### **Compensation**

Participants will receive no additional compensation for participating in this study.

**Participation**

All students in the Fall 2008 Freshmen Academy Social Sciences learning community are invited to participate in this study. Those students who choose not to participate will be excluded from the project but will continue to complete all necessary assignments required in their Freshmen Academy course. Of those students who do volunteer to participate, you have the right to withdraw at anytime or refuse to participate entirely without jeopardy to your class status, grade or standing with the university.

**Questions about the Research**

If you have questions regarding this study, you may contact Dana Erskine at 344-4871, or via e-mail at [danaerskine@utah.gov](mailto:danaerskine@utah.gov).

**Questions about your Rights as Research Participants:** If you have any questions you do not feel comfortable asking the researcher, you may contact Dr. Christopher Dromey at 422-6461. Dr. Dromey's office is located on campus in room 133 TLRB.

I have read, understood, and received a copy of the above consent and desire of my own free will to participate in this study.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Appendix F

MSI Handout Given To Students

## Metacognitive Skill Instruction

**Step 1 - Identify the task at hand:** This step helps students identify the information they need to know to understand what the professor is asking them to do. Questions to ask yourself include:

1. What am I being asked to do? (Write a paper?) (Conduct an experiment?)
2. What is the teacher asking me to learn? (Steps for a procedure?) (Historical content?)
3. What do the instructions state are the objectives, goals, requirements of the assignment? (Highlight them) (Does a plan of action come to mind?)
4. What were my first reactions when I read the problem? (Write them down)
5. Do I already know something about this problem that I can use to help me get started?
6. Do I understand all the terms/words in the assignment?

**Step 2 - Determine an initial approach to the task:** This step helps students identify prior knowledge and learning strategies that might be helpful for the task at hand. Questions to ask yourself include:

1. Although I may already possess information and strategies from my past that would work with this task, are there new ways of learning the teacher wants me to try?
2. What other approaches could be used to solve this problem?
3. Of the ideas that come to me, what information and strategies will be the most effective?
4. What sequence should the process or approach take? (First A, then B, then C)
5. How much time and effort will this problem require?

**Step 3 - Monitoring yourself as you work through the task:** This step has two major parts

**3A** - This step helps students look for ways they can process information more efficiently. Questions to ask yourself include:

1. Do I slow down and focus my attention on important or new information?
2. Do I understand important relationships presented in the material?
3. Do I create my own examples or draw pictures/diagrams to make information more meaningful?
4. Am I using how the information is organized in the book or presented by the teacher as a tool to help me learn?



5. Do I need to re-evaluate my assumptions of the subject to better understand this material?
6. Do I have a deep enough understanding of the information to be able to summarize what I've learned after I'm finish? (If not, who can I ask for help?)

**3B** - The second part involves self-testing strategies used to monitor and correct *comprehension and performance errors* that limit the effective solving of problems. Questions to ask yourself include:

1. What are my thoughts now as I am working through the problem?
2. Am I clear on my understanding of what I am doing /do I need to go back and re-read information that was not clear?
3. Am I using relevant information effectively or am I throwing in too much or assuming the teacher knows what parts I am leaving out?
4. Do I need to break this task down into smaller steps to make it more manageable?
5. Am I planning ahead to my next move or task requirement?
6. Am I using my plan to reach my goal?
7. Should this path I have chosen be abandoned and an alternative used instead? If so, is there anything that can be salvaged?

**Step 4 – Evaluation:** Appraising your work, your performance, and your strategy effectiveness. Questions to ask yourself include:

1. What do I think about the solution I reached?
2. What worked, what didn't, what would I do differently next time?
3. Did I find myself analyzing the usefulness of strategies while I studied?
4. Did I use my intellectual strengths to compensate for my weaknesses?
5. Did I learn as much as I could have/should have?
6. Are there any other options I should consider before I consider this task complete?

## Appendix G

### Freshman Academy Initial Metacognitive Assignment

## Metacognition Assignment

### Applying Metacognitive Skills to Understanding a Syllabus

Assignment for today:

Analyze your syllabi using metacognitive skills as a guide to planning for academic success in your classes this semester. This involves answering four overarching questions for each class:

- 1.) [**Identify the assignment**] How can I use this syllabus to “learn” how to do well in this class this semester?
- 2.) [**Determine an initial approach**] How can I use this syllabus to help me make a plan to do well in this class this semester?
- 3.) [**Monitor**] How can I monitor my progress and adjust my performance as I create a plan for doing well?
- 4.) [**Evaluate**] How can I evaluate my performance as I work on the syllabi and make final adjustments to my plans or modify my approach in the future?

Most of our time today will be spent working on questions 1 and 2 from above.

Working as a group, we will begin by using the syllabus from University 101 to determine what you need to learn to be successful in this class and by identifying the major and minor assignments, their purposes, and the dates you need to schedule in order to be prepared for class and meet deadlines. You should also consider the relationship between these assignments and what your teacher has said in the syllabus about what they want you to learn (their goals, objectives, purposes).

After we complete a plan for University 101, each member of your group will choose a different course in your learning community and create a similar plan for that course based on the syllabus. Then, each member of your group will present their plan and help you enter the details into your planner.

Work systematically through each course - one at a time -sharing what you learned about your assigned course syllabus with each other and entering items in your planner. When you share your plans with each other, remember you will begin by answering the first question above and not just jump to putting individual items in your planner.

After you enter the items in your planner, you will suggest to your peers strategies they can use to monitor their progress and evaluate their performance that will help them learn from the course.