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Exploring the Relationship between Metacognition and Academic Achievement

The of Case of Students of English Language in Laarbi Tébessi University

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Abstract

Through noticing the striking differences between students' scores in different areas of study the past four years, we decided to embark on the journey of investigating the reason behind this variation and understating what can be done to enhance students' academic performance. The current study attempts to explore the relationship between metacognitive awareness and academic achievement of students in Laarbi Tebessi University at the department of English Language. The target sample consists of 70 students (16 males and 54 females) which was randomly selected from second and third year licence, master one and two Language Sciences speciality. To answer the research questions, we used a survey and a correlational method, in addition to content analysis technique. The results reveals that students possess a high level of metacognitive awareness which correlate positively with their GPA scores. Moreover, metacognitive awareness appears to be a predictor of academic achievement, and the analysed exams have different percentages of metacognitive requirements which, in turn, correlate negatively with students' scores in these exams. These findings are interesting enough to draw the teachers' and school principals' attention to highly consider teaching metacognitive skills in classrooms.

Key words: Academic achievement, metacognitive awareness, metacognitive requirements.

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Dedication

To the one who lightened every path I chose, to the one whose presence meant perfection, my backbone, my rock, my dearest, to you my friend A. SOUANE…

We would like to dedicate this work to our teammate A. SOUANE who has passed away before having the chance to be proud of what we have accomplished as a team. We are so grateful we had the chance to experience her warmth and endearing personality. She truly was the embodiment of charisma, uniqueness, nerve, and talent. She will be dearly missed but never forgotten.

List of Abbreviations and Acronyms

CRESST : the National Center for Research on Evaluation, Standards, and Student Testing

GAP : Grade Point Average

IQ : Intelligence Quotient

KMA : The Knowledge Monitoring Assessment

LASSI : The Learning and Study Strategies Inventory

N : Number

MAI : Metacognitive Awareness Inventory

M1 : Master one

M2 : Master two

MSLQ : Motivated Strategies for Learning Questionnaire

p : Probability

r : Pearson coefficient

SAT : Scholastic Assessment Test

SPSS : Statistical Package for the Social Sciences

SRS : Stratified Random Sampling

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General Introduction

1. Background of the Study

Teaching as a sacred profession aims at enabling students to become both successful learners in the short-term and role model citizens in the long term. In any academic context, students are often encouraged to be critical thinkers and problem solvers. This purpose can be attained through developing the habit of questioning their entire learning process, starting from being aware of the reason behind the choice of various learning strategies over others in solving cognitive problems to assessing the efficiency of each strategy. Interestingly, such behaviors are considered as key features of metacognition (Wilson & Conyers, 2016).

Despite the relentless endeavors of school principals and teachers to help equip students with the necessary social and cognitive skills to measure up in their academic careers, many of them still struggle to accommodate their modest skills with the growing demands of educational curriculums. This sparked attention in the field of education to investigate the possible factors affecting academic achievement. To accurately identify what leads students to fail or succeed in classes is a demanding, labor intensive process as many psychological, pedagogical and environmental factors seem to have a hand in influencing academic achievement. However, this did not prevent scholars from investigating these factors. Throughout reviewing the literature, metacognition and metacognitive awareness appeared persistently in accordance to academic achievement. In fact, many studies did not only find a positive correlation between the two variables, but also accounted metacognition as a pre requisite for high levels of academic achievement (Langdon et al., 2019; Harrison & Vallin, 2018; Abdellah, 2015). Clearly, the importance of metacognition in educational contexts is unquestionable.

The abundant amount of research conducted on metacognition emphasizes how critical it is in assisting students to enhance their academic achievement and optimize their understanding (Langdon, et al., 2019; Harrison & Vallin, 2018; Abdellah, 2015; Perry, Lundie, & Golder, 2019). Hence, as college students, we got more intrigued to investigate the relationship between academic achievement and metacognition and understand the spectrum of its influence on students' academic performance.

2. Significance of the Study

Exploring the relationship between metacognition and academic achievement in the University of Laarbi Tebessi shall provide a broader understanding of the factors that seem to influence academic achievement. However, despite the overwhelming number of arguments asserting for the crucial role of metacognition in ameliorating students' academic scores, it is still far from being the only factor that influences academic achievement. In fact, the reason behind excelling in certain areas of study may not be related to students' high level of metacognitive awareness per se; rather, the nature or the type of questions that students encounter in exams may simply fail to assess high levels of intellectual ability and do little to encourage them to use high order of thinking skills which are inherently related to high levels of metacognitive awareness. Consequently, accounting for another factor, which is the metacognitive requirements of exam questions asked in different modules, may unravel more about what seems to lead students score high or low marks in different subjects. Furthermore, this will bring attention to the fact that getting high scores does not always reflect students' high levels of metacognitive awareness and thorough understanding the content of these modules.

3. Statement of the Problem

Studying education psychology in third year license was challenging for the majority of students. Statistics provided by the teacher of this module confirmed our assumption (the percentage of students who passed the exam did not exceed 35%). The struggle to excel in this module have persisted afterwards, making students develop a wrong fixation about how difficult it is in comparison to others. In the same year, students achieved high scores in modules like pragmatics for example. Remarkably, this variation in scores between the two modules continued as well. This raised many questions to why they failed in one class and succeeded in the other. According to the literature, there are different causes that may have contributed to students' failure in classes. What is quite probable, though, is that the lack of metacognitive awareness highly contributes to low academic achievement. Consequently, we felt eager to further investigate the relationship between metacognitive awareness and academic achievement. Moreover, this has also sparked our interest to understand how can the nature of exam questions asked in different modules require different levels of metacognitive awareness to be successfully passed, and how can this influence students' scores in these modules. Perhaps a study which investigates the relationship between the two variables and analyses the questions asked in different modules would provide more details about what seems to make students score differently.

4. Research Questions

In order to investigate the relationship between metacognitive awareness and academic achievement, we will try to answer five research questions:

- To what extent are students aware of their metacognitive skills?

- Do metacognitive awareness and academic achievement correlate?

- How does metacognitive awareness predict academic achievement?

- Does the nature of exam questions asked in certain modules require different levels of metacognitive requirements?

- Does metacognitive requirements of exams correlate with students' academic performance?

5. Hypotheses

Since there are five research questions, we proposed five hypotheses, each of which corresponds to a specific research question:

- The majority of students of English in Laarbi Tebessi University have low level of metacognitive awareness.

- Metacognitive awareness has a positive correlation with academic achievement.

- Metacognitive awareness is likely to predict academic achievement.

- There are variations in the levels of metacognitive requirements in different modules.

- Metacognitive requirements of exams correlate negatively with students' scores.

6. Method

Following a survey method, we administered a questionnaire to the sample to measure the level of students' metacognitive awareness. Afterwards, we conducted a correlational study to figure out the relationship between the students' Grade Point Average (GPA) scores in this year's first semester (2019-2020 academic year) and their questionnaire scores. Then, we applied content analysis technique, thematic analysis specifically, in order to analyze exam questions chosen from different academic levels to figure out whether these questions require different levels of metacognitive awareness to be solved or not. Lastly, we used a correlational method, once again, to understand the relationship between the level of

metacognitive awareness estimated in different modules (metacognitive requirements) and students' scores in these modules.

7. Sample

This study takes place at Laarbi Tebessi University, Faculty of Letters and Foreign Languages, Department of English. Using the Stratified Random Sampling strategy (SRS), the sample is selected from four levels: second, third, in addition to master one (M1) and master two (M2) language sciences specialty. The reason behind choosing this strategy is the large population size along with the diversity of its characteristics that will be best represented by the SRS (Hayes, 2019). The sample size consists of 70 participants distributed over the four levels following this formula: (sample size ÷ population size) x stratum size (see table 01).

Table 1

Population and Sample Size

Academic level	2nd year	3rd year	M1	M2	Total
Number of students in stratum	105	67	52	61	285
Strata sample size	26	16	13	15	70

8. Data Collection Tools

Data about students' level of metacognition is collected using an adapted version of the Metacognitive Awareness Inventory (MAI). The MAI is a questionnaire developed by Schraw and Dennison (1994) to measure the level of metacognitive awareness. Basically, it comprises two sections, and each section accounts for a specific factor of metacognition; the first one includes statements that aim at measuring knowledge of cognition factor whereas the second section is concerned with assessing regulation of cognition factor.

As for the second variable, academic achievement is measured by students' GPA scores, in addition to their scores in different modules collected from the admiration after the consent of professors. The latter scores serve to answer the fifth research question to figure out the correlation between the levels of metacognitive awareness covered in the exams and students' scores in the corresponding modules. Before doing this, we collected exam questions from professors that are in charge of teaching each module with the help of our supervisor so as to conduct the content analysis and answer the fourth research question.

9. Data Analysis and Strategy

Once we receive the MAI from the students, we proceed to enter the data to the Statistical Package for the Social Sciences (SPSS20) software and calculate the scores of each returned questionnaire. Since there are no findings discussing how to determine the level of metacognitive awareness using the MAI scores, we decided to compare the students' mean scores in the MAI to the original average and total scores of this questionnaire; scoring below the average, falling far away from the total score, indicate low levels of metacognitive awareness, and scoring above the average, approximating the total score, reflect high levels of metacognitive awareness. In the same respect, we discussed normality of data and standard

deviation statistics to have a clearer idea on how spread out the majority of scores are from the mean so as to answer the first research question.

Afterwards, we calculated the correlation between the two variables (Students' GPA scores and their scores in the MAI) using Pearson correlational coefficient in order to answer the second research question. Moreover, we discussed statistics related to simple linear regression mainly R square, ANOVA and B coefficient values, all of which were generated using the SPSS20 software, to explain how metacognitive awareness can predict academic achievement, thus answering the third research question.

We conducted a qualitative thematic content analysis and quantified the findings using the Nvivo12 software to answer the fourth research question. First, we depended largely on percentages generated from Nvivo12 to investigate the variations of metacognitive awareness estimated in each exam. Once again, there are no guidelines in the literature to accurately determine this. So, we suggested that exams in which coded data related to metacognitive awareness exceeds 65% are very demanding of high levels of metacognition, from 50% to 65% account for average levels of metacognition and below 50% indicate low levels of metacognition. Second, the decision to decide which question belongs to which theme resided on analyzing the semantic meaning of key words used in these questions. Third, we accounted for some details concerning the cognitive complexity of some questions like the level of analytical processes required to answer exam questions and the diversity of including different types of high order thinking skills to compare and contrast between exams that share close percentages.

As for the fifth research question, we collected students' scores in each exam, entered the data to SPSS20, along with the percentages, and calculated the relationship using Pearson correlational coefficient.

10. Structure of the Study

This dissertation is divided into a theoretical chapter and a practical chapter. The first chapter includes one section discussing mostly metacognition, in addition to details accounting for its relationship with academic achievement. Second, the practical chapter is divided into two sections which are research methodology and data analysis and discussion.

Chapter One: Literature Review

The first time we have ever been introduced to the term metacognition was in a course of educational psychology. Such sophisticated, fancy word can sound intimidating specially to learners of English as a foreign language, and it did, at least to us. Yet, it piqued our curiosity and fed into our lust for discovery and hunger for knowledge. Many questions echoed in our minds during that session, as whispers of "what lies beyond cognition" mingled with feelings of wonder called to unravel more about this topic. Driven by enthusiasm and ambition, we dared to study this phenomenon that was, surprisingly, left unnoticed in previous dissertations despite the great weight it carries in the field of psychology. We started the long lasting journey to learn more about it. Little did we know that all what we have been taught about metacognition in class that day was just the tip of the iceberg. Despite its relatively new history in this field, a myriad of journal articles, books and reviews popped up the moment we started searching for this concept. We decided to base our investigation to understand more about its relevance to academic achievement. We tried our best to cover as much information as we possibly could to provide little glimpses on its definition, the different ways in which it was presented by accredited scholars, how it can be measured, its importance to academic achievement, and how it can be easily confused with other concepts which can, ultimately, pose a challenge when discussing the relationship between metacognition and academic achievement. This investigation remains a humble attempt to inspire other students to get out of their comfort zone and challenge themselves to discuss other important concepts in the field of educational psychology that have yet to be recognized in our university, including metacognition.

1. Definition of Metacognition

Scholars interested in educational psychology have been scrutinizing the notion of metacognition for many years to have a more profound understanding of the learning process. Broadly speaking, metacognition was predominantly related to students' self-awareness of their own learning. So, what does this word exactly mean? In ancient Rome, people used to call the posts placed at the end of racetracks to indicate a turning point metas. Likewise, metacognition can be regarded as a turning point in understanding how human beings learn. Meta is also a prefix loaned from Greek meaning beyond or after. Understandably, metacognition is a concept that mirrors what is beyond cognition. As stated by Fished (1998), Flavell (1979) explained it as the ability to transcend the cognitive processes of thinking and knowing to become self-reflexive and aware of one's own thinking. Simply put, metacognition is "the act of thinking about thinking" (Longdon, et al., 2019, p. 414).

In academic contexts, metacognition is the extent to which learners can identify where they are standing in the learning process, what is involved in thinking, and what strategies work and do not work for them (Abdellah, 2015; Longdon, et al., 2019). In other words, it is the learners' ability to become self-critical of their own progress and use strategically a set of techniques and skills to solve required tasks.

Numerous scholars share the same perspective when it comes to defining metacognition as a cognitive attempt to accommodate one's skills and abilities to meet future learning needs (Flavell 1979; Hennessey 1999; Schraw & Moshman, 1995). That is, the effective self-manipulation of knowledge in order to make adjustments during learning for the sake of meeting a cognitive goal (Lai, 2011). Additionally, Weden (as cited in Lai, 2011) asserted that metacognition is a system of interrelated high order of thinking skills which was

developed from previously accumulated learning experiences. As a matter of fact, this system helps in monitoring cognitive processes.

In cognitive psychology, scholars accounted for metacognition as the capability of maintaining control over the entire learning process (Langdon, et al., 2019). As argued by Schraw (1998), metacognition is the conscious cognitive behavior of employing different strategies and skills in different educational contexts, claiming that these skills are not related to the level of Intelligence quotient (IQ), which can also be referred to as "General Intelligence"; IQ refers to a numerical measurement of someone's intelligence after they take a specific test. Interestingly, it has been reported that these skills may reconcile for low IQ averages (Lai, 2011).

Before proceeding to discuss any further details about metacognition, it is important to note that this concept has been referred to differently by scholars. For instance, Veenman, Prins, and Verheij (2003) regarded it as metacognitive skills or metacognitive skillfulness, Schraw and Dennison (1994) coined the term metacognitive awareness whereas Pintrich, Smith, Garcia, and McKeachie (1993) chose the word metacognitive learning strategies, just to mention a few. Since these terms seem to communicate almost the same idea, and Schraw and Dennison's framework of metacognition (1994) was chosen to be studied in this dissertation, we will, most of the time, reference metacognition in terms of metacognitive awareness and its constituents unless we want to discuss other scholars' perspectives and explanation of the term.

Needless to say, we do not claim that we would provide a wall-to-wall coverage of the concept, nor do we try to detach one framework from another. All frameworks provided by scholars are interrelated and serve the same core idea.

2. Different Views Explaining Metacognition and its Constituents

A large area of research in psychology has been devoted to discuss metacognition in multiple domains especially in education. In the past forty years, a lot of ink has been spilled to provide explanations of the term and propose different descriptions of the various sub processes of metacognition (Longdon et al., 2019; Lai, 2011). Fascinated and passionate to untangle the complexities of metacognition, Flavell (1976) was the first to address this concept, providing updates and new ideas about the topic in later publications. Pretty much every explanation that came afterwards depended largely on his findings. For an overview, he (1979) regarded metacognition as a set of skills which enable the appropriate manipulation of cognitive processes, insinuating that people who possess high levels of metacognition have a great flexibility of going through many processes like selecting information, evaluating and revising knowledge, strategies and goals. More importantly, Flavell (1979) proposed a model describing the different components that make up metacognition which we will thoroughly discuss later on.

On the other hand, scholars like Baker and Brown; Cross and Paris; Jacobs and Paris; Paris el al.; Pireira-Laird and Deane, Schraw and Dennison, among many others (as stated in Sperling, Howard, Miller, & Murphy 2002) hold an alternative view accounting for two main components of metacognition mainly knowledge about cognition, encompassing other sub types of knowledge, and regulation of cognition or cognitive regulation, including other sub processes. Endorsed by many scholars, the latter view seemed to resonate more among psychologists than the first one. Different explanations describing different types of knowledge of cognition have been reported in the literature. Similarly, regulation of cognition has been further debated and scrutinized by multiple scholars (e.g., Schraw & Dennison 1994; Haller, Child, & Walberg, 1988). You can have a look at some of the findings that highlight

similarities and differences between scholars' use of terminology to describe both components of metacognition (see appendix A).

2.1 Flavell's Explanation of Metacognition

Flavell's research paper published in 1976 was a huge breakthrough as the term metacognition was officially introduced for the first time in the field of psychology. This article was the steppingstones to establish one of the most influential theories to date in education. Reasonably, the concept of metacognition was refined by Flavell several times (1971; 1976; 1979).

In 1971, He explained metacognition mainly on the basis of the influence that regulation and monitoring of knowledge processes have on memory which he referred to as metamemory. Five years later, he (1976) elaborated more on his previous explanation stating that metacognition is predominantly concerned with the conscious, active and intentional monitoring and regulation of different cognitive processes in any form of a cognitive transaction in order to accomplish a goal or an objective.

In another research paper published in 1979, Flavell broke away from his old views on metacognition through recognizing its influence on other aspects of human cognition. He acknowledged that metacognition goes beyond memory related processes. In fact, social interaction and personality development are also, among many other cognitive transactions, affected by metacognition. Additionally, Flavell (1979) refined his view regarding the idea of being conscious and intentional when using metacognition. His modern view suggested that people can very well use metacognitive skills unconsciously, and can either fail to activate metacognitive processes to attain a certain goal or succeed in the activation stage but fail in the appropriate application of these processes.

Last but not least, the American psychologist (1979) managed to develop the first formal model to discuss the different components of metacognition. This model included classes of phenomena which he divided into metacognitive knowledge, metacognitive experiences, metacognitive goals and tasks, and metacognitive strategies and actions. Moreover, Flavell (1979) clarified the difference between several key concepts mainly metacognition vs cognition and metacognitive awareness vs metacognitive knowledge. In later publications, he (1979; 1993) further elaborated on the regulatory aspect of metacognition.

2.1.1 Flavell's model of metacognition

2.1.1.1 Metacognitive knowledge

Flavell (1979) explained metacognitive knowledge through its three main categories: person variables, task variables, and strategy variables. In his words, "Metacognitive knowledge is that segment of your (a child's, an adult's) stored world knowledge that has to do with people as cognitive creatures and with their diverse cognitive tasks, goals, actions, and experiences. An example would be a child's acquired belief that unlike many of her friends, she is better at arithmetic than at spelling." (Flavell, 1979, p. 906).

Person variables are the assumptions and beliefs people hold regarding their own or other people's cognition. Such assumptions can be manifested through, for example, recognizing which learning style students prefer or believing that some people are more aware than others. These beliefs can be detrimental in helping or hindering the performance of learners in academic contexts depending on how positive or negative they are.

Task variables are mainly concerned with self-informed, subjective opinions or judgments that someone has about a specific task. Holding these opinions to a high standard of validity is very unlikely since they are influenced by peoples' subjective views; what seems

to be a difficult, poorly designed, unreliable task for someone might just be the opposite for another person. However, this category of metacognitive knowledge provides, to some extent, data that help in planning to approach problems, managing the process of task completion and expecting the outcomes after solving a problem.

Strategy variables are all about the first attempt learners make to select cognitive processes to achieve goals and sub goals that were set by an individual. In fact, this category is likely going to help learners set appropriate goals because they have already an idea about the strategies that may help in their accomplishment. Flavell (1979) acknowledged the fact that the success in making use of this category is highly dependent on the success of mastering person variables and task variables.

2.1.1.2 Metacognitive experiences

As for metacognitive experiences, Flavell (1979) explained it as not only the conscious recall of past experiences, but also the subjective opinion about the responses a person has regarding his/her own metacognition (metacognitive knowledge, goals, or strategies); i.e., someone's personal view about his/her quality of cognition. As maintained by Flavell (1979), metacognitive experiences appeared to vary greatly in duration and in the time in which they occur. However, they play a vital role in helping people to reflect on the progress they made, assess their level of comprehension, engage them in meaningful learning and provide solid grounds to predict the time and effort needed to complete future tasks.

Besides, Flavell (1979) reported that stress has a substantial impact on the effectiveness of retrieving past events as challenging tasks tend to strengthen the ability to have more profound metacognitive experiences unlike routine, stress-free tasks that tend to subside the ability to remember what happened before, during or after a cognitive transaction. In fact, metacognitive experiences can occur in a form of a stream of consciousness as

individuals may depend on past experiences and background knowledge as resources to solve a current-moment problem.

With all the emotional complexity that characterizes people's responses to their own cognition, we can understand how significantly their interests shift in pursuing different future tasks and careers; tasks that provoke pleasant experiences and satisfaction are likely going to be pursed in the future and the opposite is true. Flavell (1979) also stressed the importance of personal experiences in shaping someone's monitoring abilities. As he (1979) stated, people's interests that developed through experiences are significant to the concept of monitoring and regulation because they account for peoples' future decisions to adapt or discard cognitive activities in any cognitive transactions.

2.1.1.3 Metacognitive goals and tasks and metacognitive strategies

The third and fourth components of metacognition listed by Flavell (1979) are metacognitive goals and tasks and metacognitive strategies. Firstly, he explained metacognitive goals and tasks as the individual's planned objectives of what to accomplish after completing a cognitive task. In fact, metacognitive goals and tasks encompass a long list of cognitive objectives including comprehension of information, producing written or oral materials, solving a math problem or simply widening someone's background knowledge about a certain subject, just to name a few. Flavell (1979) stressed the fact that metacognitive goals and tasks can be applied successfully only if people accessed and applied metacognitive knowledge and experiences appropriately. Later on, he (1987) provided more details on this category by proposing task diversity as a factor that helps mastering metacognitive goals and tasks. According to him, the more the learners come across tasks with different objectives, the greater the chance to objectively tell apart easy tasks from challenging ones, and the better it becomes to set goals and objectives that best align with their intellectual abilities.

Secondly, Flavell (1979) introduced the term metacognitive strategies to provide more details regarding the aspect of monitoring of knowledge. As he explained, such strategies require the appropriate manipulation of metacognitive skills and a high level of metacognitive awareness. The appropriate application of metacognitive strategies provides many advantages to leaners as they become able to be fully in charge of their own learning process, prepare plans before engaging in a cognitive task, adjust learning strategies to the difficulty of the task and objectively assess the outcomes and the progress of goal achievement. Interestingly, the former strategies could be stimulated to fulfill goals within the cognitive or metacognitive framework, further details will touch on the difference between metacognition and cognition in the following title.

2.1.2 Flavell's perspective on the difference between metacognition and cognition.

The decision to make a clear cut distinction between cognitive and metacognitive strategies is very challenging as the two concepts seem to encompass similar strategies. To make things more complicated, the boundaries between metacognitive and cognitive processes are blur, and to accurately label certain knowledge using these terms is a daunting process.

For instance, declarative knowledge, which is one of the subcomponents of knowledge of cognition, is people's awareness of their cognition and the factors that may influence their thinking; if someone is able to recognize his/her struggles to comprehend principles of bio chemistry, is this knowledge cognitive or metacognitive in nature? Although it does fall under the concept of metacognitive knowledge which was discussed by Flavell (1979), it is not quite apparent why it has been labeled so since the word metacognitive is directly related to monitoring and regulation processes, the kind of key words that are absent in the definition of metacognitive knowledge (Livingston, 2003, p. 3). As stated by Livingston (2003)

“Knowledge is considered to be metacognitive if it is actively used in a strategic manner to ensure that a goal is met…Simply possessing knowledge about one's cognitive strengths or weaknesses and the nature of the task without actively utilizing this information to oversee learning is not metacognitive” (p. 4).

Flavell (1979) weighed in on this point and explained that the difference is a matter of how this knowledge is used, i.e. the strategies that accompany the application of such knowledge help determine its nature. According to him, the strategies used by a learner as a first attempt to understand something are called cognitive strategies; accordingly, knowledge accessed in this situation is cognitive in nature. Once the learner senses that these strategies are not helping much in comprehension, metacognitive strategies take over to assess the level of comprehension and deploy other learning strategies to compensate for the lack of understanding, making the type of knowledge used by the learner in this situation metacognitive in nature. In other words, metacognitive and cognitive strategies are interrelated; what sets apart one type from the other is the way in which people make use of them.

As stressed by Flavell (1979, p. 909), metacognitive strategies help individuals oversee and supervise the process of attaining a cognitive goal. Hence, these strategies necessarily precede and subsequently follow cognitive strategies. Furthermore, the same strategy can be regarded as metacognitive or cognitive depending on the purpose of using it. Self-questioning, for instance, can be used for different reasons; either we ask ourselves questions to seek more knowledge (cognitive strategy), or to monitor and regulate our comprehension (metacognitive strategy)

In any learning process, metacognitive and cognitive strategies and processes are mutually dependent and complementary to each other, any attempt to isolate one type without acknowledging the other is insensible (Livingston, 2003, p. 5).

2.1.3 Flavell's distinction between metacognitive knowledge and metacognitive awareness.

Metacognitive knowledge and awareness are two different concepts according to Flavell (as stated in Perfect & Schwartz, 2002). From what we can understand, the term metacognitive awareness used in this section does not necessarily correspond to the same concept presented by Schraw and Dennison (1994). Flavell's distinction resided primarily on the process of retrieval.

As a quick reminder, metacognitive knowledge is described as peoples' awareness and recognition of what they know and do not know about the world i.e., their cognitive strengths and weaknesses (Flavell, 1979). Presenting true-to-life examples proposed by Perfect and Schraw (2002, p. 5) might be a useful way to conclude Flavell's point of view. As stated in their book, someone from Europe who is not very well acquainted with geography may easily show his or her ability to recall the names of capitals of Western Europe, and his or her inability to name the capitals of the nations of Africa without necessarily having to engage in conscious retrieval. Along the same lines, someone can show his great knowledge about the sport of tennis and his total ignorance about cricket unlike others who may share a totally different opinion. Therefore, when discussed separately, this knowledge is a mere description of someone's repertoire of knowledge and is highly unlikely to provide sufficient help to engage in any conscious retrievals of past cognitive transactions.

Metacognitive awareness, conversely, is concerned more with the emotional state and the actual experience that people go through during a cognitive process, which Flavell

referred to as metacognitive experiences. To better illustrate, we shall discuss the second example provided by Perfect and Schraw (2002); someone was asked to recall what happened during last series of a cricket game played between the nations of the West Indies and England. The first person is barely able to recall any details concerning the events related to the story. He is likely to be able to recognize that some events happened once he is told the whole story, but he still has quite a shallow image when he was asked to recall everything on his own. The second person is able to remember vividly every single detail related to the story from the score, to the time and even the stress he went through during the last moments in the game. Suggestively, this example implies that people who successfully engage in conscious retrievals and accurately recall past experiences are more likely to be metacognitively aware than others. Unlike metacognitive knowledge, metacognitive awareness enables retrieving event-based memories which usually require focused attention and deep levels of comprehension to be encoded.

The latter examples are quite reminiscent of what happens in classrooms; some students are excellent at retrieving learned materials and can make accurate judgments about what information they have and have not been exposed to in the past and, subsequently, are likely able to revise their goals, strategies and objectives accordingly. Others struggle to recall learned materials and are likely unable to recognize what have or have not been taught in class. A pleading account for this variation is students' different levels of metacognitive awareness (Perfect & Schraw 2002; Ghetti, 2003).

2.1.4 How did Flavell explain monitoring and regulation of cognition?

Flavell (1979) described monitoring and regulation of cognition as metacognitive processes that help someone control any cognitive transaction he/she may engage in, and these processes are strongly attached to metacognitive experiences. In fact, metacognitive

experience is the hallmark he proposed to explain how monitoring and regulation processes are triggered during task performance. As specified by Flavell, the acquisition of these processes relies on engaging in experiences, and their appropriate application in new, yet similar, situations is a matter of recalling what have and have not worked as strategies before. As long as someone engages in new experiences frequently, a pattern recognition process will develop to allocate appropriate specific regulatory processes to specific problematic situations. Furthermore, they can serve as quality control checks which can help learners make use of metacognitive processes like reflection, comprehension monitoring and goal assessment. Consequently, metacognitive experiences are important in modifying and refining metacognitive knowledge, goals and task in addition to metacognitive strategies (Flavell, 1979).

Along the same lines, in one of Flavell's most prolific publications, further details have been provided regarding the process of monitoring. Influenced by the work of Jean Piaget and Vigotsky, Flavell and other scholars (1993) published a book that examined the cognitive development of human beings, alluding to the vital role of self-regulation and metacognitive monitoring in knowledge construction. In fact, monitoring was explained through children's ability to become self-regulated and use metacognitive monitoring. According to them, self-regulation is the transition that children go through as they become self-aware of their cognition and able to control their mental processing. Similarly, they described metacognitive monitoring in terms of the skills that help in knowledge construction; children gradually learn how to think critically about both their cognition and the deployment of cognitive skills in order to understand the world around them. The strategic way in using these cognitive processes in the future is what was referred to as metacognitive monitoring.

The authors of this book did not discard the notion of experiences as a factor contributing to cognitive development; rather than focusing on how metacognitive monitoring

processes like planning, allocation of knowledge and strategies, reflection, goal assessment and self-regulation are fostered by experiences, they were more interested in describing the developmental stages of each process.

2.2 Other Researchers' Description of Metacognition's Components.

After Flavell's model of metacognition (1979), research related to this subject started to flood in as his research ignited the desire to unfold the mysteries behind the role of metacognition in education. It was compelling to understand what high achievers know that low achievers do not, what helps students succeed academically and what skills are necessary to learn. Of course, metacognition has not been restricted exclusively to the domain of learning and academic achievement. Actually, it was studied across many domains. What we are interested in is reviewing some findings which explain metacognition in accordance to learning and, at the same time, suggest a view that is different from the one proposed by Flavell (1979). Overall, these findings acknowledged three main types of knowledge within the component of knowledge of cognition (Lai, 2011; Sperling et al., 2002). Likewise, regulation of cognition was explained using different terms related to monitoring and regulatory processes.

2.2.1 Discussing differences in explaining the constituents of knowledge of cognition across multiple academic domains.

While Flavell (1979) explained knowledge of cognition in terms of "metacognitive knowledge" encompassing three distinct variables (Person, task and strategy), other researchers like Cross and Paris, Kuhn; Schraw, Crippen, and Hartley; Schraw and Moshman (as stated in Lai, 2011) have deviated from this categorization proposing an alternative framework to the explanation of knowledge of cognition. Essentially, three sub types of knowledge of cognition have been identified in the literature as declarative knowledge,

procedural knowledge and conditional knowledge. Strikingly, although sharing the same perspective in this categorization, researchers did not agree on the same exact description of these sub types of knowledge and, in fact, used different terms and contexts to elaborate on each type (Lai, 2011; Anderson, 1993; Hiebert & Lefevre, 1986; Star, 2005). The following lines will only focus on the fundamental differences in explaining each type of knowledge of cognition and how it varied across different academic contexts.

As for declarative knowledge, cognitive psychologists Paris and Winograd (1990) described it as the conceptions that someone has about what makes human beings able to process cognition; they proposed the term self-appraisal to demonstrate what these conceptions are largely based upon. According to them, self-appraisal is a cognitive and unique mechanism that human beings use to reflect upon their repertoire of knowledge. In philosophical terms, Kuhn and Dean (2004) explained it in relation to the concept of epistemology; that is, one's ability to use their cognitive awareness to differentiate between sound and unsound beliefs, opinions or knowledge. For Schraw, Crippen, & Hartley (2006), it was rather viewed as what students generally know and understand as far as their own cognition is concerned. They further explained it as not only what learners possess as knowledge but also their awareness of the factors that may or may not affect their progress in any learning situation, more details will be provided to further elaborate on this explanation under the title discussing Schraw and Dennison's framework of metacognition (1994).

In the spectrum of mathematical contexts, declarative knowledge (also referred to as conceptual knowledge) was explained differently in comparison to the definition proposed in the context of psychological discourse. According to Hiebert and Lefevre (1986) (as stated in Star, 2005, pp. 407-408), declarative knowledge adheres only to the deeply understood, sophisticated type of information which is characterized by plentiful of connections. This was a huge departure in explaining what declarative knowledge is especially from the

psychological stand point which did not recognize the aspects of richness of connections and deep understanding of information when referring to it. For example, the concept of "a dog" has different prototypes in the human mind according to different levels of understanding; "a dog" for a young child is not the same for an adult. In psychology, both prototypes can be regarded as declarative knowledge. However, weak understanding of concepts, like the child's conception of a dog, is discarded by mathematicians to be acknowledged as declarative knowledge, specifically by the ones who agreed with Hiebert and Lefevre's perspective.

Unlike declarative knowledge, researchers agreed, to some extent, on the description of procedural knowledge. Generally speaking, any commonsense knowledge encoded in the form of sequenced rules or steps that help in goal accomplishment fall under the notion of procedural knowledge. Simply said, it is the knowledge of how to do something (Lai, 2011). However, little was agreed upon when it came down to the quality of connections that exist within this knowledge. In the context of mathematics, for example, not all tasks that learners may encounter are alike; some tasks require algorithm procedures whereas others necessitate heuristic procedures. Hiebert and Lefevre (1986) (as stated in Star, 2005, pp. 408-409) regarded knowledge related to algorithm procedures as the sum of predetermined, sequential steps that should be respected in order to solve a problem. The name algorithm denotes the nature of these procedures; if someone blindly respects the order of all the preexistent sequence of steps to solve algorithm problems, he/she would definitely reach the solution without committing any errors. Therefore, this type of procedures was described as superficial, rote and lacking high quality of connections. Subsequently, this description could be extrapolated to other learning contexts as far as the task proposed can be solved through following well defined steps. When it comes to solving more sophisticated and challenging problems, algorithm type of procedures becomes ineffective as the learners lack the privilege

of having a preexisting plan describing the sequence of steps that lead to problem solution. Leaners are in need of executing heuristic procedures; i.e., making wise choices about how to use generic procedures and rules of thumb to reach a solution. Heuristic procedures are sophisticated and have a high quality of connections. From a psychological perspective, most of procedural knowledge adheres to the definition of heuristics procedures, adding the fact that this knowledge can also be implicit and subconscious through constant practice.

Lastly, the terminology used in explaining conditional knowledge has been consistent throughout the literature, with reporting differences in accounting for the concept of information connections as a fundamental part of its definition. According to psychologists, this knowledge is primarily concerned with the ability to know under what conditions each type of knowledge (declarative or procedural) can be used to solve a problem. Appropriate manipulation of this knowledge equips learners with a sophisticated cognitive asset that provides awareness of when, where and why to use knowledge or procedures in specific contexts (Baker & Brown; Cross & Paris; Jacobs & Paris; Paris et al.; Pireira-Laird and Deane, as stated in Sperling el al., 2002). However, this generic definition overlooked the concept of information connection that may explain why some learners fail to make use of this knowledge. Anderson (1993) (as stated in Turns & Van Meter, 2011, p. 7) has elaborated more on the strength of relationships and connections between information that exist in this knowledge through coining the term “rule based knowledge network”. Based on his explanation, the strength of relationships that characterizes this network has a great influence on helping in the appropriate execution of a task. Furthermore, he suggested the term “condition-action pairs” to indicate that the knowledge of procedures application i.e., the procedures involved in performing an action or solving a task, is stored simultaneously with the conditions under which they should be used. The accurate selection of the appropriate procedures in new contexts is further influenced by the matching of condition recognition

process, or familiarity with the new conditions under which the new task is presented, with the stored "condition-action pairs"; a mismatch between the two would most likely inhibit learners from selecting the suitable knowledge and procedures to solve required tasks.

2.2.2 Discussing differences in explaining regulation of cognition.

The controversy around reporting consistent explanations discussing the constituents of metacognition lingered as the literature persisted in yielding differences concerning the descriptions proposed by scholars to explain regulation of cognition as well. Scholarly documents like (Shcraw & Moshman, 1995; Schraw & Graham, 1997; Schraw & Dennison, 1994; Schraw, 1998) explained regulation of cognition in accordance to regulatory activities/processes such as planning, monitoring or regulating, and evaluating, among many others. Haller et al. (1988) described it in terms of mental activity clusters called monitoring and regulating. Other findings used the terms knowledge monitoring (Tobias & Everson, 2002; 2009) and self-management of thinking (Jocobs & Paris, 1987).

In the following paragraphs, more details will be discussed about scholars' word choice in explaining regulation of cognition. Nevertheless, since we have chosen the framework of Schraw and Dennison (1994) that acknowledged this component as "regulation of cognition" per se, we preferred to discuss it separately in the next title. Whenever the term "regulation of cognition" appears in accordance to other scholars, it does not necessarily mean that they literally used it in their works; we just chose it as a reference to see how other scholars used other terms to elaborate on this concept.

Haller et al. (1988) discussed regulation of cognition in the context of reading comprehension. In this context, it was explained through two separate mental activity clusters called monitoring and regulating. According to them, monitoring entails a range of skills including setting goals, paraphrasing and summarizing information, and connecting new

learned materials with background knowledge, that eventually would help students navigate their way through the process of text comprehension. Regulating, on the other hand, refers to "compensatory strategies to redirect and bolster faltering comprehension" (Haller et al., 1988, p. 6).

In a much broader context than the one proposed by Haller et all. (1988), Tobias and Everson (2002; 2009) merged the two clusters discussed earlier into one concept called knowledge monitoring to mirror what metacognition entails, with devoting a special attention to the component of regulation of knowledge. The model proposed by Tobias and Everson (2009) argue that the appropriate application of numerous and advanced metacognitive activities and regulatory processes like planning, appropriate selection of learning strategies and evaluation are highly dependent on the success of monitoring of knowledge. Essentially, metacognitive processes can be presented in a hierarchical order, with monitoring at the base of the pyramid. As stated by Tobias and Everson "We believe that monitoring of prior learning is a fundamental or prerequisite metacognitive process… If students cannot differentiate accurately between what they know and do not know, they can hardly be expected to engage in advanced metacognitive activities such as evaluating their learning realistically, or making plans for effective control of that learning" (Tobias & Everson, 2002, p. 1).

In the same vein, Pintrich, Walters, and Baxter (2000) proposed an interesting analogy between the process of knowledge monitoring and a thermostat to clarify the role of knowledge monitoring on regulatory processes. The thermostat's objective is to regulate the temperature of a certain environment or activate the heat if the temperature falls to a certain degree, resembling a lot the objective of knowledge monitoring; just like the thermostat, knowledge monitoring triggers the learners to accommodate their learning strategies to the difficulty of a task. That is, it provides students with the ability to self-assess their own

cognition and ultimately become self-aware of their own understanding. Therefore, they are likely going to adjust their behavior, motivation and strategies to the challenges of the required task.

Returning to the context of reading comprehension, Jacobs and Paris (1987) described regulation of cognition through using the term self-management of thinking encompassing planning, evaluation and regulation. They argued that self-management is "the dynamic aspects of translating knowledge into action" (p. 259). As opposed to the static aspect of metacognition that was referred to as self-appraisal of cognition, learners are required to actively use knowledge to monitor and control the learning process (Jacobs & Paris, 1987).

Thus, the differences reported in literature regarding this component does not lie fundamentally in its definition, but rather in proposing different avenues of interpretations that are, in turn, influenced by the researchers' area of interest and school of thought.

3. Schraw and Dennison's Framework of Metacognition

As hinted above, there is no general consensus among researchers on the division of metacognition into sub components. Among the numerous frameworks and countless conceptualizations of metacognition, it seemed very convenient for us to adapt the framework proposed by Schraw and Dennison (1994) to explain the constituents of metacognition because the questionnaire (MAI) used in this work was also developed by them. It is worth mentioning that Schraw published other influential findings elaborating on the explanation of each sub component (Schraw & Graham, 1997; Schraw, 1994; Schraw el al., 2006; Schraw & Moshman 1995; Schraw, 2000; Schraw, 1998). Consequently, a large body of information will be cited from these sources as Schraw and Dennison's work (1994) did not provide rich information in describing these sub components since their research focused primarily on testing out the validity of the MAI. Like many other frameworks, this one recognized two

components of metacognition: knowledge of cognition and regulation of cognition. Accordingly, sub processes of each component are going to be explained as stated by Schraw and Dennison (1994).

3.1 Knowledge of Cognition

Knowledge of cognition refers to what learners know about their cognitive processes and how they can use this knowledge in self-reflection (Schraw, 1994; Schraw el al., 2006). Schraw and Dennison (1994) stated that "Knowledge about cognition includes three sub processes that facilitate the reflective aspect of metacognition: declarative knowledge (i.e., knowledge about self and strategies, procedural knowledge (i.e., knowledge about how to use strategies), and conditional knowledge (i.e., knowledge about when and why to use strategies." (p. 460).

Elaborating more on these types, declarative knowledge refers to the ideas and concepts that a person has in his or her memory. More specifically, it is what learners know about their cognition as well as their awareness about what may affect the learning process. That is, this knowledge is related to learners overall understanding of the aspects that affect their academic success. As maintained by Schraw and his colleagues, high achievers are equipped with the ability to become aware of the factors that affect their cognition like memory, along with the strategies that influence someone's capacity to memorize information such as rehearsal and distributed learning (Schraw & Graham, 1997; Schraw, 1994; Schraw el al., 2006; Schraw & Moshman 1995; Schraw, 2000; Schraw & Dennison 1994; Schraw, 1998).

Procedural knowledge entails information about how to accomplish a task. Briefly said, it is the repertoire of procedures about how to use strategies to solve problems. Learners who are proficient in using a considerable number of different strategies in an automatic way

are more likely to have a high level of procedural knowledge (Schraw & Graham, 1997; Schraw, 1994; Schraw el al., 2006; Schraw & Moshman 1995; Schraw, 2000; Schraw & Dennison, 1994; Schraw, 1998).

Similar to what have been discussed above about psychologists' understanding of conditional knowledge, Schraw and his colleagues related it to the judgments that are involved in choosing to work with a specific set of strategies among many others to solve problems. In fact, conditional knowledge refers to the ability to understand for what reason and in which situation it is most effective to make use of declarative and procedural knowledge, thus helping learners to be more selective in identifying what strategies are more useful to solve tasks. Interestingly, this knowledge also provides great flexibility for learners to alternate between different strategies in order to adapt to the difficulty of the assigned tasks (Schraw & Graham, 1997; Schraw, 1994; Schraw el al., 2006; Schraw & Moshman 1995; Schraw, 2000; Schraw & Dennison 1994; Schraw, 1998).

3.2 Regulation of Cognition

Cognitive regulations refer to how one's learning can be manipulated and controlled. As a matter of fact, regulation of cognition encompasses a set of regulatory processes that help in controlling cognitive activities and determining to what extent learners succeeded at accomplishing a particular cognitive task (Schraw and Dennison, 1994). These regulatory processes include Planning, information management, comprehension monitoring, debugging strategies and evaluation (Schraw & Dennison, 1994).

First, we shall discuss Planning and information management. Planning is defined as going through important preliminary steps before engaging in the learning process including planning the materials, setting goals, and allocating resources. On the other hand, information management is chiefly concerned with different strategies used by learners to better

understand and process information such as summarizing the main points discussed in class, using elaborative techniques to link prior knowledge with newly learned knowledge, organizing information in a comprehensible way, in addition to be able to engage in selective focusing which helps students distinguish between what information is relevant and what is not (Schraw & Dennison, 1994; Schraw, 1998).

Second, monitoring of comprehension and debugging strategies. Comprehension monitoring reflects the ability to assess one's learning or strategy use through undergoing a process of periodic self-checking. If students can recognize what information has been learned and what strategies have helped in the goal achievement periodically, they can assess their progress in the learning process and make the necessary changes when needed. Consequently, monitoring of comprehension prompts the learners to embark on another higher level of monitoring activities known as debugging strategies which permits to refine comprehension and correct performance; after properly assessing progress and comprehension, learners can deploy techniques to compensate for the setbacks they may have had during solving a cognitive task (Schraw & Dennison, 1994).

The last regulatory process discussed in this framework is evaluation which was referred to as consciously reflecting on the effectiveness of the strategies used to meet the objective after finishing a cognitive task. Evaluation may also encompass awareness of someone's performance in tests, assessment of the effectiveness of the plan they used to meet their goals, and most importantly, reconsideration of using other plans to approach the problem and improve performance (Schraw & Dennison, 1994; Schraw & Graham, 1997; Schraw, 1994; Schraw el al., 2006; Schraw & Moshman 1995; Schraw, 2000; Schraw, 1998).

4. Measurements of Metacognition.

The diversity in reporting theoretical frameworks discussing metacognition combined with the challenges researchers face to study such an implicit, complex behavior resulted in developing different methods and measuring tools for its assessment. Veenman and Spaans (2005) accounted for the brief relationship between the method of measurement and the way in which it was used in tasks to provide a rationale behind his classification. As argued by them, there are three possible ways to implement the tool of measurement in a specific task(s); before task performance, during task performance or after task performance. Correspondingly, the relationship can be described as probable, simultaneous, or retrospective. Henceforth, depending on the procedures taken in the research, methods of measurement can be categorized under these terms. Other researchers divided such methods into two broad categories mainly offline and online methods. We shall discuss the latter categorization as it appears to be the most widely used among scholars (Jacobse & Harskamp, 2012; Akturk & Sahin, 2011).

4.1 Offline Methods

Jacobse and Harskamp (2012, p. 135) provided though description of offline methods. According to them, the label offline refers to the fact that the instrument has been applied before or after task performance, thus providing researchers with the privilege of choosing when to administer their questionnaires or interviews. As a result, these methods gained a lot of recognition and are actually largely used in research to measure metacognition. In this regard, multiple self-report questionnaires have been developed by scholars, most notably the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich & De Groot), the Learning and Study Strategies Inventory (LASSI; Weinstein et al.) and the Metacognitive Awareness Inventory (MAI; Schraw & Dennison 1994) (as stated in Jacobse & Harskamp, 2012) in

addition to interviews. Broadly speaking, all of these questionnaires and interviews present general statements to assess knowledge and regulation of cognition. Despite their popularity, the risk in reporting accurate assessment using offline methods, especially assessment of regulation of cognition, is significant, and this can, in turn, be traced back to the participants' inaccurate responses affected by memory distortion issues and social desirability. Taking the fact that regulation of cognition is generally related to strategy use during a task, offline methods are probably more suitable for measuring knowledge of cognition factor.

On the other hand, interviews can serve as a tool which can provide more in depth information about the participants' answers in comparison to self-report questionnaires; during interviews, the researcher can elaborate more on students' responses and, ultimately, have access to data that he/she would not have been able to obtain using self-report questionnaires (Akturk & Sahin, 2011, p. 3734).

4.2 Online Methods

Jacobse and Harskamp (2012, pp. 134- 136) covered interesting details about online methods as well. The two scholars defined online methods and discussed the most commonly used measuring tools associated with them like think aloud protocols and systematic observation.

As opposed to offline methods, online methods are concerned with measuring on going skills as they are performed by students during solving a cognitive problem. Undoubtedly, such measurements provide a greater insight on students' level of metacognition and are likely able to accurately reflect their accuracy in monitoring and regulating cognitive processes. Apparently, measuring tools related to these methods outnumber the ones reported in relation to offline methods; think aloud protocol, systematic

observation and monitoring accuracy are among the most used online method tools in research.

Think aloud protocols attain for recording verbalized thoughts reported by students during task performance and, subsequently, transcribing these records from which metacognitive processes are going to be inferred. Quite remarkably, when using such tool, all the disadvantages reported in regards to offline methods can be avoided because student do not need neither to recall what strategies they used in previous tasks, nor to report dishonest beliefs prompted by social desirability; their strategies implemented in the task are recorded on the spot and can be objectively studied by the researchers. However, despite how reliable they are, think aloud protocols can be time consuming and very costly. Besides, it is infeasible to use such method with large sample sizes and in places like regular classes. As a matter of fact, in most researches, this method was reported to be applied particularly in laboratories and only with small sample sizes.

The second method reported in the literature is systematic observation through which students' cognitive behaviors are observed and recorded by researchers. In this case, behaviors during task performance are directly recorded without necessarily having to instruct the learner to verbalize his/her thoughts. For example, researchers can examine the different strategies employed by learners to approach a problem, then infer how sophisticated their ways of thinking are. Accordingly, judgments about their levels of metacognition are going to be made in correspondence to the cognitive complexity of their own thinking and the effectiveness of their strategy use during solving a cognitive task.

The third method that is worthy to be discussed regarding online methods is measuring monitoring accuracy. The Knowledge Monitoring Assessment (KMA) is one of measuring tools that can be used in such method (Tobias & Everson; 1998). Young and Fry (2008, pp. 2-

4) elaborated on the procedures followed by researchers in assessing monitoring accuracy. As reported in their research paper, students are required to pass a test in two stages; first, they have to report their judgements about future performance regarding each question presented in the test, which was referred to as making local judgments, then provide their answers to each question in the same test. Later on, the average difference between students' actual answers and their estimation of performance (local judgments) in each question in going to be calculated, providing insight on their level of local monitoring accuracy. In addition, judgments about the overall performance in the test is also needed to measure what is called as global judgments. Following the same technique, the average between students' overall performance in the test and global judgment results is supposed to account for their level of global monitoring accuracy. Arguably, Local and global monitoring accuracy help reflect students use of ongoing metacognitive regulations during a test and assess their overall repertoire of metacognitive regulations respectively (Nietfeld , Cao, & Osborne, 2005).

Although recognized as one of the most reliable measurements of metacognition, monitoring accuracy measurements are unlikely to provide adequate information about students' level of metacognition; As stated by Jacobse and Harskamp (2012) "accuracy measures give insight into a limited part of metacognitive processes (monitoring by looking forward or looking backward and thinking ahead about a solution plan)" (p.137). Therefore, it is recommended to accompany such method with other online measurement tools.

5. The Importance of Metacognition to Academic Achievement

By the 1970's, the notion of metacognition has gained tremendous interest in the field of education (Harrison & Vallin, 2018). A substantial body of research have weighed in on the effects of metacognition on academic achievement (Langdon, et al., 2019). Some findings revealed that students who are more metacognitively aware tend to excel in schools in

contrast to those who lack metacognitive awareness, pointing out that metacognition can also stand as a predictor of academic scores (Harrison & Vallin, 2018, p. 16). In the same respect, Wang et al review's (1994) reported that metacognition is considered as one of the most powerful predictors of academic performance. In another review titled How People Learn, the National Academy of Sciences (2000) advocated for the positive influence of metacognitive approach in teaching and the benefits of its implementation in schools. Furthermore, in the Visible Learning research conducted by Hattie, (as stated in Langdon, et al., 2019, p. 414), different factors used in the study were ranked from best to worst in terms of their influence on academic achievement. Out of 195 factors, metacognitive strategies were ranked 46th, asserting for the fact that these strategies do have a significant impact on students' academic achievement.

Arguably, metacognitive awareness or metacognition enables students to become attentive towards the effectiveness of learning strategies use and aware of their progress in the learning process which help them regulate their cognitive processes accordingly. Additionally, high achievers who were shown to possess high metacognitive awareness accurately predicted their performance and the strategies that are most likely going to help in solving the task, unlike low achievers (AbdEllah, 2015, p. 561).

The overwhelming advantages of metacognition to high academic achievement continue to pour in as it was regarded by Oz (2016) as an essential skill that pertains learners' self-awareness about cognitive regulations which eventually enables them to successfully manipulate knowledge and effectively utilize strategies in learning. Put differently, it fosters students' capabilities to evaluate the effectiveness of the various strategies they have been using in order to filter out what fits their needs and what does not. During the process of solving tasks, it was reported that learners would, simultaneously, make use of their cognition

as a resource for information, and depend on metacognitive awareness (metacognition) to decide for the appropriateness of strategies and skills involved in the process.

On top of this, metacognition is deeply wired to the ability of students to recognize what is understandable and what is ambiguous, make accurate judgments about their level of comprehension and report on what information have been discussed before and have not (August, Flavell, & Clift, 1984; Ghetti, 2003). Moreover, it is widely known that college students depend largely on reading texts in their academic careers. In fact, understanding and retaining information from texts is crucial to academic success in any area of study, especially when it comes to teaching English as a foreign language (Chen, 2014). According to Flavell (1979), monitoring of reading and assessment of comprehension are related to metacognition.

In another research conducted by Everson and Tobias (1998), the KMA's scores were highly correlated with students' performance in English end course, humanities and Grade Point Average (GPA). Further testing of this instrument yielded interesting findings as the KMA's scores were not only correlated with academic achievement but also able to predict academic success in college. In the same vein, Nietfeld et al. (2005) conducted a longitudinal experiment to examine the relationship between students' performance in a series of multiple choice test administered throughout a semester and their level of local and global monitoring accuracy. Expectedly, local monitoring accuracy levels were strongly related to students' test scores.

More empirical findings were reported to support the relationship between metacognition and academic achievement. Most notably, the MAI, after being tested by Schraw and Dennison (1994), revealed a statistically significant relationship between knowledge of cognition factor and high academic performance. Furthermore, the MAI scores, mainly the knowledge of cognition factor, appeared to correlate positively with reading

comprehension tests (Schraw & Dennison, 1994). Other subsequent studies have found positive relationship between metacognition, as measured by self-report questionnaires, and academic achievement (Veenman & Van Hout-Wolters, 2002 as cited in Jacobse & Harskamp, 2012; Young & Fry, 2008).

To be fully transparent, offline methods used to measure metacognition, especially self-report questionnaires, had a fair share of setbacks when correlating with measurements of academic achievement. For example, Sperling, Howard, Miller, and Murphy (2004) were eager to further investigate the relation between scores of the MAI and high school score averages in addition to Scholastic Assessment Test (SAT) math scores. Unexpectedly, not only the MAI scores did not correlate with high school score averages but also correlated negatively with SAT math scores. Also, it is unclear in Schraw and Dennison's research (1994) whether the regulation of cognition factor correlated positively with measurements of academic achievement or not. In fact, this factor did not correlate with other reliable measurement tools like monitory accuracy in reading comprehension context.

6. Convergence of Metacognition and Intelligence and its Relation to Academic Achievement

Despite the countless findings reporting strong relationships between metacognition and academic achievement, we should be very cautious to underestimate the influence of other variables especially the ones that hold meaning similar to the notion of metacognition like intelligence (Sternberg 1986; 2000). Similar to what have been reported about the advantages of metacognition, intelligent students are also quick and efficient to process information, able to set plans before solving tasks and work strategically as opposed to less intelligent learners (Conway, Cowan, Bunting, Therriault, & Minkoff, 2002). More importantly, definitions of metacognition and intelligence highly converge when considering

the explanation proposed by Sternberg (1986; 2000) in which he related meta components of intelligence to metacognitive activities. Moreover, the boundaries between the two variables become almost indiscernible when VandenBos (2007) described intelligence as "The ability to derive information, learn from experience, adapt to the environment, understand, and correctly utilize thought and reason" (p. 488). Consequently, intelligence is definitely an important idea to tackle when discussing the relationship between metacognition and academic achievement as it was reported in a meta analytical review published by Ohtani and Hisasaka (2018) as a possible confounding variable.

The literature reported metacognitive models attaining for the interference of intelligence in the relationship between metacognition and academic achievement, and whether or not metacognition is a part of the toolbox related to intelligence (Ohtani & Hisasaka, 2018). Overall, three prominent models were presented to discuss the trichotomy relationship between metacognition, intelligence, and academic achievement which are the intelligence model, the independent model and the mixed model (Veenman, Elshout, & Meijer, 1997) (see appendix B for a summary of the models).

First, the intelligence model accounts for this variable as the central factor in influencing academic achievement, and metacognitive activities are merely a depiction of someone's intelligence. The argument for this is that highly intelligent students tend to manifest a strong ability to regulate and monitor their cognitive processes, and therefore succeed academically. In addition, low intelligence measurements are most likely correlated with the inability to engage in any self-regulated processes.

Second, the independent model regards the two variables as relatively unrelated yet equally important factors as far as their relationship with academic achievement is concerned. In this model, both variables have been considered as strong predictors of academic

performance, each of which has its relatively distinct components that underlie other sub processes and, in fact, have a significant influence on academic achievement. Contrary to the first model, this one has been substantiated by some empirical findings (e.g., Swanson 1990; Maqsud 1997).

The third model known as the mixed or comparison model is a hybrid combination of the latter models. Essentially, it recognizes a mild relationship between intelligence and metacognition, with implying that metacognition can be considered as a stand-alone predictor for academic achievement when intelligence is controlled. Interestingly, many empirical research findings support this model (e.g., Gomes, Golino, & Menezes, 2014; Minnaert 1996; Veenman et al., 2014).

It stands to reason that the variable of intelligence can very well obscure the results attaining for the relationship between metacognition and academic achievement because both concepts tend to largely overlap. Conceptualizing this complex relation into a clearer and more comprehensive models, Veenman el al. (1997) contributed to understanding the possible ways in which intelligence can be a confounding variable.

Unriddling the secrets behind metacognition is a treacherous slope because the roots behind this theory date back way before Flavell coined this term. Metacognition is a modern, complex theory that embodies numerous ideas that have been crafted by psychologists for decades to explain how human beings learn. In fact, what is cognition and how to control it are questions that researchers and scholars wrestled with since the dawn of humanity. Using philosophers', thinkers' and psychologists' insights, metacognition assembled a glossary for navigating such complicated issues. Quite understandably, we felt overwhelmed by the incredible amount of research related to this topic and selected, delicately, the most relevant

concepts that would lay the foundation to understand metacognition and, simultaneously, serve the purpose of our research.

Chapter Two: Fieldwork

Thus far, we understand that the influence of metacognition on academic achievement has been largely substantiated, and its relevance to deep levels of understanding is far from being debatable. Our research aims at measuring the participants' level of metacognitive awareness using the MAI and estimating coverage percentages of metacognitive requirements in five exams using content thematic analysis. Subsequently, we can investigate the relationship between the values of metacognitive awareness estimated from the latter measuring tool and data analysis strategy with students' GPA scores in addition to their scores in these exams respectively. Moreover, this study discusses how metacognitive awareness can predict academic achievement. Overall, this chapter covers data analysis and discussion of the findings in which we provide a brief description of our sample, research methods used in this work, data collection instruments and procedures. Lastly, we analyze and discuss the data at hand.

Section One: Research Methodology

In this section, we revisit some concepts mentioned in the general introduction and discuss more details about the sample, research methods, data collection tools, data analysis and strategies and, more importantly, the procedures we followed in this research.

1. Description of the Sample

The target population in this study includes 285 undergraduate students spread out on four academic levels enrolled in the English Language Department at the University of Laarbi Tebessi, Tebessa, 2019-2020 academic year. The sample selected from this population consists of 70 students (53 females and 17 males). The total response rate reached 45.7%, more details are displayed in Table 2.

Table 2

Response Rate

Academic Level	Percentage of Response Rate
Second Year License	7.14%
Third Year License	12.9%
Master one, Language Sciences	5.71%
Master two, Language Sciences	20%

Notice that some participants were substituted with students' outside of our sample size in order to increase the response rate (8 females and 24 males responded to the MAI).

2. Research Method

Our study uses a variety of research methods including a survey method, a correlational method and thematic content analysis. We used a survey method to measure students' metacognitive awareness using the MAI, content analysis to analyze five exams in order to estimate metacognitive requirements covered in each one, and a correlational method to explore the relationship between metacognitive awareness and academic achievement measurements.

3. Data Collection Tools

3.1 The Adapted Version of the MAI

The first instrument used in this research is an adapted version of the MAI (see Appendix C). This questionnaire encompasses two sections: the first one is related to basic demographic data about the participants (first name, last name, educational level). The second section is concerned with presenting 52 statement aims at measuring metacognitive

awareness. In fact, these statements measure two factors of metacognition which are knowledge and regulation; 17 questions measure knowledge of cognition and the 35 remaining statements account for assessing regulation of cognition. In contrast to the dichotomous scale Schraw and Dennison (1994) used in the MAI, participants in this study can rate the statements on a 5 point Likert scale, ranging from: 1 = Not at all typical of me, 2 = Not very typical of me, 3 = Somewhat typical of me, 4 = Fairly typical of me, and 5 = Very typical of me. Correspondingly, we add up the scores of the statements that belong to each factor in order to estimate students' awareness of knowledge of cognition (scored on 87 points in total) and regulation of cognition (scored on 175 points in total). Logically, adding up the scores related to the two factors together accounts for the total estimation of metacognitive awareness (scored on 260 points in total). As mentioned in the general introduction, we failed at finding any evidence in the literature which entails for a standardized description of the level of metacognitive awareness based on these scores. Thus, we opted for comparing the MAI mean scores of the participants with the total and average score of the questionnaire to distinguish between low levels and high levels of metacognitive awareness.

To test the reliability of the MAI, we conducted a pilot study on a random sample (N= 15) and used the Alpha Cronbach formula and the Split Half procedure to test the internal consistency between the items in this questionnaire. The findings in Tables 3 and 4 show that Alpha equals 0.94 and Split Half equals to 0.953 which indicate that the 52 items have a high internal consistency. Consequently, this questionnaire is reliable.

Table 3

The Split Half Reliability Statistics

Cronbach's Alpha			
Correlation Between Forms	Part 1	Value	,880
		N of Items	26[a]
	Part 2	Value	,908
		N of Items	26[b]
	Total N of Items		52
Correlation Between Forms			,914
Spearman-Brown Coefficient	Equal Length		,955
	Unequal Length		,955
Guttman Split-Half Coefficient			,953

Table 4

The Cronbach's Alpha Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,945	,945	52

As far as the validity of the MAI is concerned, Schraw and Dennison (1994) used the Explanatory Factor Analysis to measure the internal structure of their questionnaire. The results yielded strong evidence supporting the two factor classification of items (the 52 items classified under the knowledge factor and the regulation factor). Thus, the MAI is a valid instrument which measures two components of metacognitive awareness (see Appendix D for more details).

3.2 Thematic Content Analysis

We used thematic content analysis to investigate the metacognitive requirements of exam questions and further explore the relationship between these requirements and the students' scores in the corresponding modules so as to have a greater insight on the relationship between metacognition and academic achievement.

A handful of recent reviews suggested systematic, well-structured approaches to use thematic content analysis (Kiger & Varpio, 2020). In fact, if carried out appropriately, it can provide tremendous help in highlighting key features and common themes across a large set of data in order to draw conclusions from. Additionally, thematic content analysis witnessed a lot of hype and recognition in recent years because it does not provide rigid plans and restrictive boundaries that have to be blindly respected; this flexibility was appealing to a lot of researchers as they can manipulate and modify this approach across many areas of study to serve the purpose of their research (Nowell, 2017).

Consequently, we decided to use thematic content analysis to analyze five exams selected purposefully to investigate how they can be related to metacognitive awareness. Since we studied these same exact modules before and through noticing the variations between students' scores in previous years, we presupposed that the exams related to these modules would require different levels of metacognitive awareness, which is what we anticipate to find at the end of this analysis in order to understand if students' scores in these exams can possibly be influenced by the different levels of metacognitive requirements estimated in each one or not.

Using thematic content analysis, researchers can depend on concept driven themes (pre-determined themes) or data driven themes (data generated themes) to analyze written documents, i.e., following a deductive or inductive approach. In this study, we applied a

deductive thematic content analysis since we worked with already preexisting themes adapted from National Center for Research on Evaluation, Standards, and Student Testing (CRESST), which were originally developed by Bloom (1956). Accordingly, we examined the semantic meaning of key words presented in questions, established a relation between these words with each theme and described the cognitive complexity of each exam. In addition, we quantified this analysis in numerical data (percentages) generated from the Nvivo12 software to spot out the variations of metacognitive awareness coded in each exam (metacognitive requirements) and, subsequently, calculated the correlation between these percentages and students' scores in the corresponding modules.

3.2.1 Credibility of Thematic Content Analysis

The credibility of this method resides largely on the credibility of the themes used throughout the analysis. Evaluation of themes in early and late stages of research by outside reviewers would enable comparison to spot out any conflicting themes and examine which ones have been added and which have been removed, thus helping the researchers to have a greater insight on what themes to choose in their work. Moreover, a review of critically acclaimed themes used in the analysis should be reported along with independent reviews discussing how well each theme succeeded in representing the analyzed texts (Alhojailan, 2012). Due to lack of time, resources and restrictive governmental measurements of social distancing, we could not adhere to such sophisticated measures of credibility reported in the literature. However, we depended on the CRESST to argue that the themes adapted in this research are critically acclaimed by independent experts to be applied across many academic settings in order to check the different levels of understanding required by exams questions, i.e., levels of metacognitive requirements.

According to the CRESST (as stated in Clay & Root, 2001), exam questions are supposed to asses five levels of understanding known as knowledge, comprehension, analysis, synthesis and evaluation. All these levels, except knowledge, were reported to be mastered by learners with high metacognitive awareness (Swanson, 1990; King 1991; Morrow, 2008; Bartha & Carroll, 2007).

The literature reviewed in the first section highlighted the importance of metacognition to comprehension. As maintained by Flavell (1979), metacognitive processes like reflecting on the struggles which students encounter in comprehension and deploying other strategies to overcome such difficulties will most likely ensure a more profound understanding of concepts. In the same respect, Schraw and Dennison (1994) touched on the importance of metacognitive awareness on comprehension through discussing the regulatory processes known as information management and comprehension monitoring. Moreover, Morrow (2008) reviewed several researches accounted for the implementation of metacognition in fostering students' levels of comprehension; a handful of studies yielded promising results as metacognitive strategies, impressively, ameliorated students' comprehension. In another research, King (1991) investigated the effects of promoting self-questioning and reciprocal peer-questioning, implemented as metacognitive strategies in classes, on lecture comprehension. Unsurprisingly, students' comprehension and deep understanding of oral materials discussed in class were superior to the students who studied the materials individually and in small cooperative groups.

Application, analysis and synthesis have been referenced in relation to problem solving abilities. In a research conducted by Swanson (1990), an endeavor has been taken to understand the possibility of metacognitive knowledge to compensate for students' low aptitudes in problem solving. This study accounted for a rather pragmatic definition of problem solving; according to this research, problem solving requires a network of high order

thinking skills and strategies including making use of background knowledge in new situations (knowledge transfer), analyzing learned information and understanding the relationships between them, being creative in solving novel problems and confidently successful in decision making. One of the results found by Swanson (1990) revealed that regardless of students' aptitudes, the group of children that possessed high metacognition, as measured by think aloud protocols, outperformed the other group that included children with low metacognition in problem solving tasks, which necessarily signifies the importance of metacognition to knowledge application, analysis and synthesis.

Finally, evaluation, the highest order of thinking skills reported by CRESST, can be explained in relation to metacognitive awareness through the process of decision making. According to Bartha and Carroll (2007), decision-making abilities reside on the competency to gather, organize, combine and evaluate knowledge. Coincidently, this definition highly converges with the one presented by CRESST. The relevance of metacognition to decision making processes is significant as Bartha and Carroll (2007) stated that "…efficient decision makers question, monitor, and instruct themselves to gain access to relevant information, to formulate a plan of action, to guide execution of the plan, and to regulate the use of cognitive strategies throughout the decision-making process." (p. 64). By necessity, evaluation of information, which is one of the manifestations of decision making processes, is highly likely to be related to metacognitive awareness.

Logically speaking, if students possess high metacognitive awareness, they would likely outperform those who have low metacognitive awareness in exams that encompass high metacognitive requirements. Consequently, these five levels of understanding were chosen to be the main categories upon which coding of data will be based throughout the thematic content analysis.

4. Procedures

After administering the questionnaire online, we entered the collected data to SPSS20 software in order to measure students' metacognitive awareness and understand its relationship to their GAP scores using Pearson coefficient. In addition, we used simple linear regression to explain how metacognitive awareness can help predict the values of academic achievement.

As for content analysis, we started with familiarizing ourselves with the data (reading the exam questions related to each module). Then, we developed a code book which contains all the details concerning the procedures followed in the categorization of each question under specific themes (knowledge, comprehension, analysis, synthesis and evaluation) (see Appendix E). Afterwards, we edited the content of exams through deleting additional information i.e., all the words that are not directly related to the questions, to make sure that the total coverage of data corresponds only to what we want to measure and, then, carried out with analyzing each exam separately by highlighting each question and adding it to the theme(s) which we discussed above. After finishing coding the data, questions that share similar themes are merged together under one node. Finally, we visualized the percentages in charts (see Appendix F) and presented "coding charts" of each exam which display the themes, the number of references, the percentages of data coded under each theme. The result of the analysis of each exam is displayed in a table followed by a short descriptive paragraph (see Tables 11, 12, 13, 14, 15).

Lastly, we calculated Pearson correlational coefficient to measure the relationship between the metacognitive requirements of exams and students' scores in the corresponding modules.

Discussing the research methodology related to this study, we shed light on the different data collection tools and procedures we have used, in addition to some details related to the description of the population and the sample size. In the following section, we analyze and interpret the findings.

Section Two: Data Analysis and Interpretation

After we laid the foundation to explain how the relationship between metacognitive awareness and academic achievement has been investigated, we can now proceed to analyze and discuss the findings. Basically, this section accounts for analyzing the data as well as for interpreting and discussing the results.

1. Data Analysis

To answer the first research question, we calculated the mean and the standard deviation of the participant's MAI scores, providing statistical data from which we interpreted students' levels of metacognitive awareness. Then, we calculated Pearson correlation coefficient in order to investigate the correlation between the MAI scores and the students' GPA scores and used simple linear regression to understand how metacognitive awareness can predict academic achievement in order to answer the second and third research questions respectively.

To answer the fourth and fifth research questions. We collected five exams from different academic levels and analyzed them separately using content analysis. After analyzing the cognitive complexity of each exam and generating percentages of data related to metacognitive requirements, we answered the fourth research question. Subsequently, we calculated Pearson correlational coefficient to understand the relationship between metacognitive requirements of exams and students' scores in the corresponding modules to answer the fifth research question.

2. Interpretation and Discussion of the Results

2.1 Findings Related to the Degree of Students' Metacognitive Awareness

In order to answer the first research question which says "To what extent are students aware of their metacognitive skills?" We calculated the mean of the respondents' MAI scores and compared them to the average and total score of the questionnaire. Table 05 below shows that the mean score equals 195.6875 and the standard deviation equals 28.03389. Clearly, the participants' mean scores in the MAI approximates the total score of the inventory (260) and is above the average (196>130). Moreover, the standard deviation is low, which makes us believe that the majority of the students' MAI scores are clustered around the mean. Hence, the majority of the participants possess high levels of metacognitive awareness.

Breaking this down into the factors which has been discussed in the first section, Table 06 shows the mean of students' scores in regulation of cognition and knowledge of cognition factors. Obviously, the mean score of regulation of cognition (130.75) roughly approximates the total score of this factor (175) and is, in fact, higher than the average (87.5); this reflects that the majority of the participants are highly aware of the regulatory processes reported by Schraw and Dennison (1994). Similarly, the mean score of the second factor (64.81) is also close to the total score of knowledge of cognition (85) and higher than the average (42.5). Consequently, it is safe to say that the majority of the participants are also highly aware of the different types of knowledge of cognition reported in the literature, especially when the standard deviation reported in both factors is low which, in turn, indicates that most of students' scores are clustered around the mean.

Based on students' low GPAs in previous years, we hypothesized that the majority of the participants' MAI scores will, at best, be average which would, eventually, align with their scores. In fact, the literature reported in the first chapter provides many arguments in

favor of the importance of metacognition to low and high academic achievement. However, students' MAI scores in this study show otherwise. Henceforth, the hypothesis which states "The students of Laarbi Tebessi University have a low level of metacognitive awareness" is rejected.

Table 05

Descriptive Statistics of the Participants' MAI Scores

	N	Mean	Std. Deviation
MAI	32	195,6875	28,03389
Valid N(liswise)	32		

Table 06

Descriptive Statistics of the Knowledge and Regulation Scores

	N	Mean	Std. Deviation
Knowledge of cognition	32	64,8125	9,82898
Regulation of cognition	32	130,8750	19,42355
Valid N (liswise)	32		

2.2 Findings Related to the Correlation between Students' MAI Scores and their GPAs

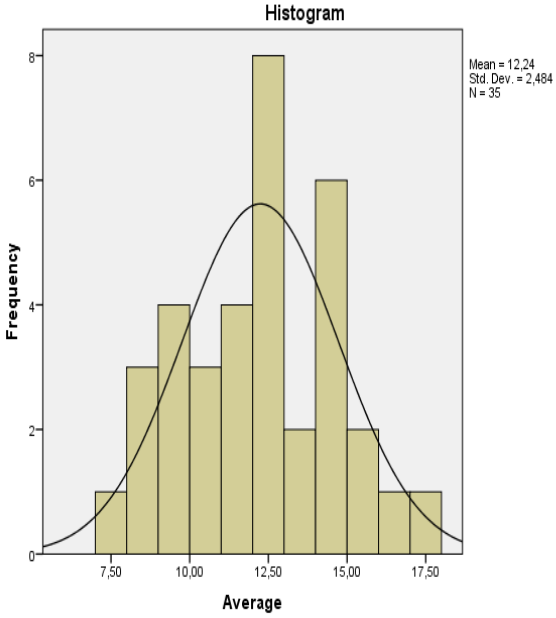
Since the data is normally distributed (see Figure 1 and 2), we calculated the correlation between the MAI scores and students' first semester averages using Pearson correlation coefficient. Table 07 reveals a weak positive (r =.361), statistically significant (p =.042 <α= .05) relationship between the two variables. As a result, the hypothesis which states that "Metacognitive awareness has a positive correlation with academic achievement" is accepted. The majority of the studies we have reviewed in the literature found similar results related to the direction of this correlation (Veenman & Van Hout-Wolters, 2002 as cited in

Jacobse & Harskamp, 2012; Young & Fry, 2008). Thus, the correlation measured in this research provides more evidence supporting the predictive validity of the MAI as far as its relationship with academic achievement is concerned. Also, the results of this study are consistent with other researchers' findings corresponding to the strength of the correlation; a meta-analysis review of 21 studies show that metacognition, estimated by self-report questionnaire including the MAI, weakly correlated (r <.17) with academic achievement (Veenman & Van Hout-Wolters, 2002 as cited in Jacobse & Harskamp, 2012). Young and Fry (2008) investigated the relationship between the MAI scores and broad measurements of academic achievement, including students' GPA scores, and found a relatively stronger relationship (r =.23) compared to the latter review. Even though we found a weak correlation between the two variables, it is still quite significant in comparison to the studies we have reviewed. Overall, the findings show that the MAI continues to yield weak positive correlations with academic achievement.

Table 07

Pearson Correlation

		Average	MAI
Average	Pearson Correlation	1	,361*
	Sig. (2-tailed)		,042
	N	35	32
MAI	Pearson Correlation	,361*	1
	Sig. (2-tailed)	,042	
	N	32	32



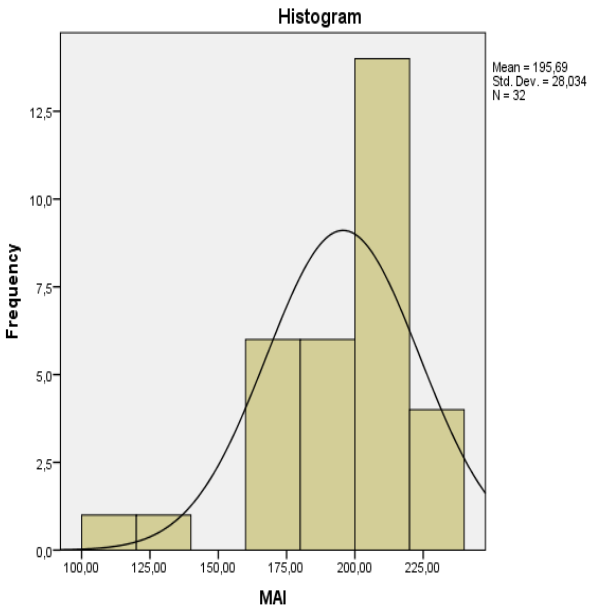


Figure 1

Histogram of GPAs

Figure 2

Histogram of MAI Scores

2.3 Findings Related to the Prediction of Academic Performance by Metacognitive Awareness

We used simple linear regression to answer the third research question. Assumptions for conducting a simple linear regression are met; the data is normally distributed (see Figure 3), the normal probability plot shows a linear effect across the two axes (see Figure 4), and the variance of the residuals, also known as heteroscedasticity, is not consistent, nor is it associated with any pattern across the predictive variable (see Figure 5). Since simple linear regression is an extension of Pearson correlation coefficient, statistical values related to R square, ANOVA, and Coefficients are discussed to further elaborate on the significance of this model and understand the power of metacognitive awareness in predicting academic achievement.

From the value of R square ($R^2 = 0.13$), we understand that only 13% of the variability in academic achievement can be accounted for by metacognitive awareness. In other words, metacognition explains 13% of the variation in academic achievement (see Table 8). Interestingly, Veenman and Van Hout-Wolters (2002) aggregated 21 studies in which metacognition was measured using self-report questionnaires and reported that the variance in academic achievement was lower than 3% in all of them. However, the sample sizes used in these studies are substantially larger than the sample studied in this research which can, in turn, explain this striking difference. As for the significance of the model, one of the values displayed in ANOVA statistics demonstrates that metacognitive awareness is a significant predictor of academic achievement ($p = 0.042 < \alpha = .05$) (see Table 09).

The statistics related to Coefficients (see Table 10) reveal important predictive values. Unstandardized B coefficient helps in expecting the average increase in the value of academic achievement if metacognitive awareness increased by one unit (+1). Subsequently, if the latter is true, academic achievement would increase by 0.033. Moreover, the table shows the point of intercept which accounts for the value of academic achievement if metacognitive awareness is, hypothetically, 0. The value of constant (5.86) suggests that if metacognition equaled 0, academic achievement would have been measured at 5.86 point. More importantly, the value 0.033 corresponds to the slope, and 5.86 is the point of intercept, both of which will help create the regression equation. We can use this equation ($y = 0.033x + 5.86$) to form the basis of predicting particular values, taking the fact that "y" refers to academic achievement and "x" corresponds to metacognitive awareness. Along the same lines, the 95% confidence interval associated with B values reveals that if we conduct this same exact study multiple times, we can be 95% confident that the intercept value would fall between -0.4 and 12.16 and the slope would be between 0.001 and 0.065.

The variation in academic achievement accounted for by metacognition, along with the values attaining for the predictability of academic scores in this research, are relatively weak, yet statistically significant, and, at the same time, way higher than some of the studies reported in the literature. Hence, the hypothesis related to the third research question which states that "Metacognitive awareness is likely to predict academic achievement." is accepted.

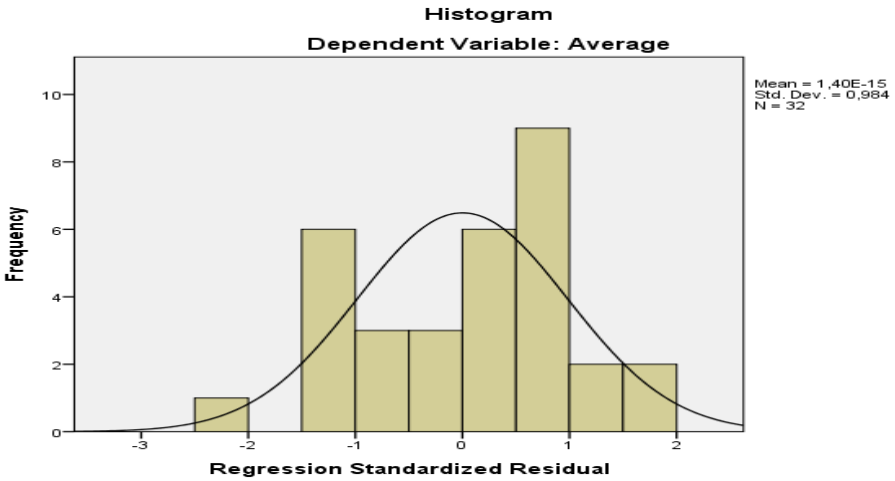


Figure 3

Histogram of Residual

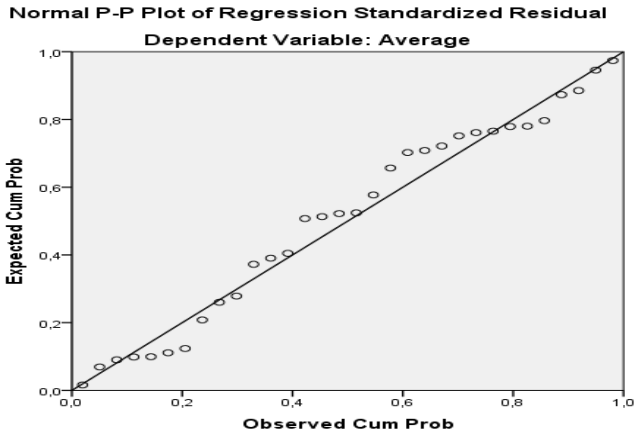


Figure 4

Normal PP Plot of Regression Residual

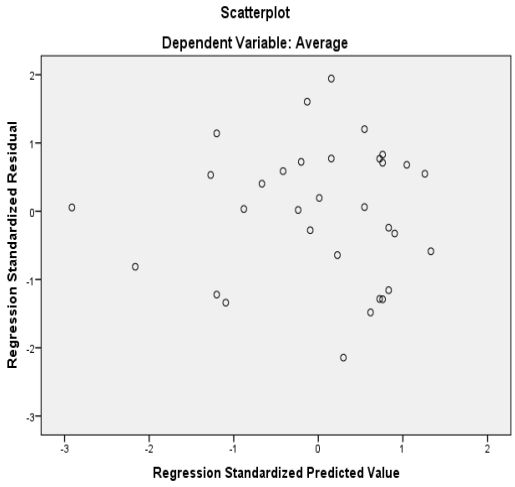


Figure 5

Scatter Plot of Residual

Table 8

R Square Coefficient Statistics

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	,361[a]	,130	,101	2.43448

a. Predictors : (Constant), MAI

b. Dependent Variable : Average

Table 9

ANOVA Statistics

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	26,635	1	26,635	4,494	,042[b]
	Residual	177,801	30	5,927		
	Total	204,436	31			

a. Dependent Variable: Average

b. Predictors: (Constant), MAI

Table 10

Coefficients Statistics

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95,0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	5,866	3,082		1,903	,067	-,429	12,161
	MAI	,033	,016	,361	2,120	,042	,001	,065

a. Dependent Variable: Average

.

2.4 Description of Exam Questions and Findings Related to Coding Percentages of Metacognitive Requirements

To answer the fourth research question, we conducted a thematic content analysis and displayed the findings in the tables below.

Table 11

Analysis of Exam 1

Level of intellectual ability	References	Description
Analysis (5 references coded [53,14% Coverage])	• **Reference 1**: 3- Researchers observed that reactive strategies for behavior management in the classroom can be associated with elevated teacher stress. Do you agree with them? Why? Why not? • **Reference 2**: 4- what type of intelligence does Ikram reveal according to Sternberg's Triarchic theory of intelligence? Justify your answer. • **Reference 3**: 4- How does this theory define an intelligent person? • **Reference 4**: 6- What's the main difference between the « I » message and the assertive discipline (taking into consideration the theories on which they are based)?	The following references contain the words "why", "justify" and "how" which are mainly concerned with assessing students' ability to analyze, thus tapping into the third level of intellectual ability known as analysis. To properly justify an answer requires not only a thorough understanding of concepts, but also the ability to make inferences and draw conclusive claims from a large set of data. In other words, a careful process of scrutinizing information to highlight relationships between concepts is essential to provide a sound argument on which the student can base his or her claim on. Quite understandably, students

	• **Reference 5**: 7-In your future career as a teacher you are supposed to teach English three sessions per week. Suppose that you feel there is a need to assign your pupils to different groups based on their different abilities and that you have the right to do that. Which type(s) of ability grouping are you most likely to choose? Explain how you are going to do that in practice and justify your choice.	with low metacognitive awareness may struggle with such questions as a large body of literature reported that analysis of data and successful argumentation lies within the repertoire of metacognitive skills.
Application (3 references coded [51,66% Coverage])	• **Reference 1**: 1-Ahmed is a first grade middle school pupil who loses his writing material almost every day. He had to buy a new book of English three times during this term. He always forgets to do his homework and he can never stay in his seat. What type of learning difficulties does he have? • **Reference 2**: 4- Amina is a student who prefers answering yes/no questions and her classmate Ikram prefers dealing with essay questions. a-Which processing approach does each of them use?	The three references mention questions that contain two parts; the first part is concerned with presenting a situation to be analyzed, and the second is about asking the problem related to that situation. Such questions target a high level of understanding known as application. Students have to understand the situations at hand, make use of their background knowledge and, then, apply this knowledge in order to answer each question correctly. The ability to solve problems in new contexts is related to high metacognitive awareness. Apparently,

	b-what type of intelligence does Ikram reveal according to Sternberg's Triarchic theory of intelligence? • **Reference 3**: 7-In your future career as a teacher you are supposed to teach English three sessions per week. Suppose that you feel there is a need to assign your pupils to different groups based on their different abilities and that you have the right to do that. Which type(s) of ability grouping are you most likely to choose?	these questions start with the words "what" and "which"; this means they are related to verbatim recall and memorization. However, verbatim recall of information in unlikely to provide help to solve the problem. When a situation is presented as a part of a question, recalled information have to adhere to the specificity of that situation.
Knowledge (2 references coded [6,63%Coverage])	• **Reference 1**: 2-Are there any gender differences in learning • **Reference 2**: 5- What are the two main categories of learners with special needs?	The following questions start with the words 'what' and 'which', meaning that they are supposed to assess verbatim recall and memorization. Students are very unlikely to engage in any high order thinking skills to answer such questions. Therefore, it is implausible that low levels of metacognitive awareness would be an obstacle to answer correctly. In addition, these questions are flat

		out direct; a direct connection will be instantly established between memorized information and the concept the question asks about regardless of the level of other intellectual ability processes.
Comprehension (3 references coded [39,17% Coverage])	• **Reference 1**: 2-Are there any gender differences in learning? If so what are the origins of these differences? Explain. • **Reference 2**: 3- Researchers observed that reactive strategies for behavior management in the classroom can be associated with elevated teacher stress. Do you agree with them? Why? Why not? Explain. • **Reference 3**: 7- In your future career as a teacher you are supposed to teach English three sessions per week. Suppose that you feel there is a need to assign your pupils to different groups based on their different abilities and that you have the right to do that. Which type(s) of ability grouping are you most likely to choose? Explain how you are going to do that in practice	The following questions contain the word "explain" which assesses students' level of comprehension. This high level of intellectual ability requires students to provide accurate and clear descriptions of main concepts in addition to their significance. Metacognitive awareness is reportedly mandatory to deep understanding of concepts which would ultimately help in describing them accurately and thoroughly. Low levels of metacognitive awareness are likely going to hinder the ability to thoroughly understand ideas and consequently contribute to the risk of failure in answering such questions. The word "explain" is almost always preceded by questions that assess verbatim knowledge which answers depend less on metacognitive

		awareness. However, the following part which instructs for providing explanations is likely going to reflect students' degree of understanding of what they have memorized.
Evaluation (1 references coded [9,70% Coverage])	• **Reference 1**: 3- Researchers observed that reactive strategies for behavior management in the classroom can be associated with elevated teacher stress. Do you agree with them?	This reference mentions a question concerned mainly with assessing a high level of understanding known as evaluation. The key word used here is "agree" which requires students to use their informed opinion to make judgments about the validity of a certain statement. Unsurprisingly, answering correctly necessitate a high order of thinking skills like comprehension, application and analysis, all of which are reportedly linked to high metacognitive awareness. Without thorough comprehension, careful analysis, and proper application of knowledge, chances are students would fail to properly evaluate this statement.

In this exam, more than 93% of data was coded under 4 levels of high order of thinking skills, with only 6.63% coded under knowledge. More importantly, four out of five high levels of intellectual understanding were assessed with varying percentages of coverage. It is worthwhile

to mention that particular skills like comprehension and application can be embedded in evaluation which was the case in this exam. With providing many novel situations and questions that require comprehension, analysis, application and evaluation to be answered, it is expected that low levels of metacognitive awareness would influence negatively the performance of students.

Table 12

Analysis of Exam 2

Level of intellectual ability	References	Description
Application (2 references coded [58,84% Coverage])	• **Reference 1:** Task One: For each of the utterances below name the speech act performedidentify its type (Searle's classification) Turn these utterances into explicit performatives. 1. Utterances: 2. If you don't come, severe measures will be taken against you! 3. How many times do I have to tell you to clean your room? 4. It sure is a beautiful day. 5. Bravo! • **Reference 2:** Task Three: Which maxims of the co-operative	Application of knowledge is largely assessed in the first and second references. As for the task presented in the first reference, students were instructed to examine four utterances then apply their knowledge to "name" the speech act and "identify" its type. Interestingly, although this task requires applying background knowledge, the situations presented are quite concise which may make students depend less of their analytical skills to infer meaning. Similarly, as cited in the second reference, this question provides four statements from which students are supposed to "identify", again, the maxims

	principle are being broken in the following? What implicatures can be drawn? 1. A: "So tell me, do you like what I did to my hair? B: "Er . . . what's on TV tonight?" 2. A: "Hmmmm, I thought I left my watch in my desk drawer before I left for Spring Break." B: "Well I definitely didn't take it. Absolutely not. There's no way I would take someone else's property. Besides, I already have my own watch. And I would never steal from someone, never." 3. A: "You're soaked! It must be raining pretty hard outside" B: "You're a regular Sherlock Holmes." 4. A: "Would you like to hear my rendition of 'Feelings'?" B: "Yes, of course. I'd love to." [it's actually the last thing you want to hear]	and their implicatures. Overall, such questions would require high levels of metacognitive awareness to be answered.

Knowledge (1 reference coded [40,55% Coverage])	• **Reference 1:** Task Two: Underline the deictic and referring expressions in the extract below. Identify their types. At Quarry Bank High School, he met his wife, Cynthia Powella. John lived a life of uninterrupted calm. Unfortunately, that calm was suddenly shattered when his mother died. John did not like to talk about the death of his mother, because it was too great a sorrow to be publicized. After the death of his mother, John went to live with his Aunt Mimi. They lived in a little house, with frilly curtains at the windows and an old apple tree in the front garden. When John was away, he thought about Aunt Mimi and her frilly curtains and her apple tree, and he realized how fortunate he was. Because, though his mother was taken away from him, he was given something precious in return.	This task is supposedly entirely devoted to assess knowledge and verbatim memorization. Although the task presents a paragraph, it does not tap into any higher level of understanding like application because the question asks merely for spotting out well identified expressions in the paragraph then instructs to identify their types. Rote memorization would likely be more than enough to answer correctly.

Contrary to the findings presented in the first analysis, a considerable withdrawal in the number of assessed skills is very apparent. All of the questions in this exam were classified under application and knowledge. In fact, 40% of data was solely coded under knowledge which already insinuates that high metacognitive awareness is not mandatory to answer such questions. However, in this exam, application has a slight prevalence with 58% of data coded under this theme. This is not to downplay the importance of high levels of metacognitive awareness to

application, but some of the situations coded under application are very straightforward which can make it easy for students to infer meaning without necessarily engaging in analytical processes. Overall, average levels of metacognitive awareness seem reasonably enough in order to pass this exam.

Table 13

Analysis of Exam 3

Level of intellectual ability	References	Description
Application 3 references coded [90,15% Coverage]	• **Reference 1: I. Sentence creation (06 pts)** 1. Think of two objects (furniture or decoration) we find in the living room. Use the names of these objects in a sentence that contains an adverbial clause of result. 2. Find the preposition that goes after the adjective "famous" and use that combination in a sentence of three clauses. 3. Create a participial phrase using the past participle of the verb 'to fight' and use this structure in a sentence of your choice. • **Reference 2: II. –ing forms (07 pts)** If it's a Gerund, indicate its function. It it's a Participial, indicate the word it modifies. If it's a Continuous form, leave the other space empty.	Application has been referenced three times through using the key words "find", "indicate", among others, and presenting new situations from which students are going to answer the questions. Actually, the first reference mentions a question that instructs students to write sentences which taps into another level of understanding known as synthesis which will be discussed in another node. Before that, it is mandatory to apply background knowledge related to the subject matter discussed in the three situations presented in this reference. Otherwise,

	A. After resting for an hour, you will feel much better. B. If you have a family, then taking a full course-load at university will be too much. C. We won't eat any of the turkey roasting in your oven. D. The magazine's cover, appealing to younger readers, will undoubtedly boost sales this month. E. Learning the apparently neutral language of the law appears to have different effects on students of different races, genders, and class backgrounds. F. Mary's downfall is eating snacks between meals G. I remember having heard this story before. • **Reference 3: III. A multitask exercise (07 pts)** Read the coming passage and answer the questions that follow it: No matter how you slice it, there are only 24 hours in a day. To be successful at university, students need to learn good time-management skills. The first skill is not taking on more than you can handle. If you are working part-time, have a family and are involved in a community organization, then taking a full course-load at university will be too much. Another time-	students would not be able to answer correctly even if they have the ability to write well-structured sentences. Hence, in this context, application is embedded in synthesis. The second reference requires, once again, applying knowledge to indicate the function of the gerund in addition to the word modified by the past participle, both of which should have already been identified from the 7 utterances provided. The third reference contain the key words “find” and “indicate”. Although it may seem that these questions assess knowledge, they actually transcend this basic level of intellectual ability to assess application. Unless students apply their thorough comprehension about the concepts mentioned in the 5 questions, they would very likely to fail answering any of them especially that the 5^{th}, 6^{th} and 7^{th} questions mention quite specific characteristics of some of these concepts that students are required to

	management skill is reasonably estimating the time required to perform each of the tasks at hand. For example, deeply reading a chapter from a course text cannot be completed in between television programmers. Finally, actually doing what needs to be done seems obvious, but is a very difficult skill. You may find that cleaning out your wardrobe becomes vital when you are avoiding study; procrastination is a time manager's enemy. By learning time management skills, your university study will be successful and most importantly enjoyable. 4. Indicate the type of the first sentence 5. Find in the passage a gerund phrase that functions as a Subject Complement. (Write the whole phrase) 6. Find in the passage the noun phrase that contains 03 separate pre-modifiers. (Write the whole phrase) 7. In the passage, find an infinitive (phrase) that can be changed into a gerund. Make the change and write the new phrase below. 8. Indicate the type and function of the underlined phrase.	find in the paragraph.

Synthesis 3references coded [24,62% Coverage]	**Reference 1: Sentence creation (06 pts)** 1.Think of two objects (furniture or decoration) we find in the living room. Use the names of these objects in a sentence that contains an adverbial clause of result. Find the preposition that goes after the adjective "famous" and use that combination in a sentence of three clauses. Create a participial phrase using the past participle of the verb 'to fight' and use this structure in a sentence of your choice. • **Reference 2: III. A multitask exercise (07 pts)** 4.In the passage, find an infinitive (phrase) that can be changed into a gerund. Make the change and write the new phrase below: • **Reference 3: III. A multitask exercise (07 pts)** 5. Add a non-restrictive relative clause to the last sentence. Place the clause anywhere you want in the sentence. Write the whole new sentence below.	The following references are supposed to assess students' ability to integrate information in order to generate and create answers to solve the problem. Simultaneously, students have to adhere to the requirements presented in the questions. In fact, most of the key words used in these questions like "create", "use", "think", "make" and "add" directly refer to the process of synthesis which requires a variety of high order thinking skills mainly comprehension and application. In this situation, synthesis also explores students level of creativity and aesthetic style of writing. It is very likely that high metacognitive awareness is related to the ability to create and generate answers to new problems. Surface levels of understanding and rote memorization are unlikely to provide sufficient help in solving such questions.

Comprehension (1 reference coded [3,94% Coverage])	• **Reference 1: –ingforms (07 pts)** Say whether the sentence contains a **Gerund**, or a **Participial** adjective, or the **Continuous** form.	What is quite noticeable in this question is how smartly, yet effortlessly, was turned from a question that assesses knowledge into a question that assesses comprehension i.e., instead of asking to identify distinct concepts that students can easily memorize, they are challenged to spot out words that cannot be distinguished unless they are thoroughly understood. Clearly, students' comprehension is targeted in this context. As mentioned earlier, profound level of understanding and comprehension is related to metacognition.

This is a quite interesting exam because many skills referenced are embedded within other skills. Statistically, application is prevalent as 90% of data was coded under this theme. This can be traced back to the reoccurrence of application as a sub process in other high order skills like comprehension and synthesis. Interestingly, almost all the questions related to application challenge the analytical skills of students and deep comprehension as they ask to identify specific characteristics of concepts and make distinctions between other ones that share similar features. More importantly, no question seems to assess knowledge on its own; 100% of the data was coded under application, synthesis and comprehension. It stands out to reason that students with low metacognitive awareness would have a hard time passing this exam.

Table 14

Analysis of Exam 4

Level of intellectual ability	References	Description
Comprehension (4 references coded [40,84%Coverage])	• **Reference 1:** 1.Explain the kind of unity (give its name) that you find in the word "blackboard" and you don't find in the combination of words "a black board". • **Reference 2:** 3.Explain the difference between General Lexicology and Special Lexicology. (Be straightforward when you explain) • **Reference 3:** 8. …give a brief account of one of them using an example. • **Reference 4:** 11. What other unit was compared with the word in terms of mobility and what does that have to do with the grammaticality of the sentence? • **Reference 5:** 10. How can sociolinguistics be of help for lexicology? List three answers.	The key word used in reference 1 and 2 is "explain" which signifies assessment of comprehension. Similarly, the 3rd, 4th and 5threferences are supposed to assess comprehension as well by asking for clarifications of concepts and their relationship with other ones. As argued above, metacognitive awareness is expected to have a significant influence on students' performance in solving these questions.

Knowledge 3 references coded [26,43% Coverage]	• **Reference 1:** 2. Give a brief account of three main ways of enriching the English vocabulary? • **Reference 2:** 6. What are the lexical units studied by Lexicology? (just name them) • **Reference 3:** 7. What is the subject matter of the following sub-branches? Comparative Lexicology Special Historical Lexicology Diachronic Lexicology Name four characteristics of the word	From the stand point of students who passed this exam, it is our assumption that these questions assess knowledge and verbatim recall of memorization. All of these questions contain the words "give", "what" and "name" without presenting any new situations to be analyzed. This persuaded us to believe that they are neither concerned with comprehension nor with application of knowledge. Therefore, it is likely that students would answer correctly the following questions irrespective of their level of metacognitive awareness.
Synthesis 2 references coded [6.53% Coverage]	• **Reference 1:** 5. Suggest 06 words that might be included in a semantic field of 'drinking vessels'.	This question aims at assessing synthesis. The key word used here is "suggest" which calls upon students' ability to integrate their background knowledge to respond to the requirements of the question. As mentioned

		before, synthesis is related to high levels of metacognitive awareness.
Analysis Reference 1 - 5,33% Coverage	• **Reference 1:** 9. Why were 'inkhorn terms' controversial? List three reasons briefly.	Using the word "why" in questions indicates assessment of analysis which is, in turn, related to high levels of metacognitive awareness.
Evaluation 1 reference coded [11,46% Coverage]	• **Reference 1:** 10. Can diachronic data be fully neglected when the synchronic state of a language vocabulary is investigated? (Be straightforward when you explain)	This question proposes an alternative way to assess the judgments of students to evaluate, apply knowledge and analyze information. Evaluation usually encompass a number of high levels of intellectual lability. Hence, it is expected that this question requires high levels of metacognitive awareness to be answered correctly.

Similar to the first exam, this one assesses a variety of high order thinking skills mainly comprehension, synthesis, analysis and evaluation, with only 26% of data coded under knowledge. In comparison to the first and third exam, the percentage of data coded under knowledge is slightly elevated. Regardless of their level of metacognitive awareness, it is expected that students would answer questions coded

under knowledge correctly without necessarily having to use any high order of thinking skills. However, data coded under the rest of skills outweighs data coded under knowledge. As a result, it is likely that high levels of metacognitive awareness is expected to have an influence on students' performance in this exam as well.

Table 15

Analysis of Exam 5

Level of intellectual ability	References	Description
Application 4 references coded [37,03% Coverage]	• **Reference 1**: 2) The primary school teacher is explaining a mathematics problem, when she sees one of her pupils poke his pencil in his classmate's arm. The teacher immediately tells her pupil that he has lost 10 minutes of recess. What type of consequences is the pupil receiving? • **Reference 2**: 3) The secondary school teacher rewards his students for every assignment they return in time. What type of reinforcement schedule is he using? • **Reference 3**: 5) At the start of first grade in primary school, the	The following references perfectly fit the description provided in the first exam; the 1st, 2nd, 3rd, and 4threferences all present situations to be analyzed in order to solve the problem, thus assessing students' application of knowledge in new contexts. What is remarkable, though, is that unlike the description provided in the second exam about the situations which were coded under application, these ones are rather compacted and lengthy which challenge students to make use of their analytical skills to examine each situation.

	ringing school bell produces no fear in Amina. Each time Amina is late to class, she is punished by her teacher for her tardiness. After a period of time, Amina starts to exhibit trembling and tearfulness whenever the bell rings. Now, Amina begins to tremble and becomes tearful whenever the oven timer rings at home. What happened to Amina in both situations? • **Reference 4**: 6) What does the concept of readiness mean in the light of Piaget's theory of cognitive development as well as in Vygotsky's socio cultural theory of cognitive development? What is its implication on teaching according to both theories? Use appropriate terminology.	
Analysis 3 references coded [7,59% Coverage]	• **Reference 1**: 3) The secondary school teacher rewards his students for every assignment they return in time. Is it always appropriate to use it why? Why not? • **Reference 2:** 4)…Is the student likely to learn how to improve the writing skills? Why? Why not?	The key words used in all these questions is "why". Clearly, students' ability to analyze information in order to provide strong arguments for their answers is assessed. As a matter of fact, analysis is related to metacognition.

Synthesis 1 references coded [9,58% Coverage]	• **Reference 1:** 2) The primary school teacher is explaining a mathematics problem, when she sees one of her pupils poke his pencil in his classmate's arm. The teacher immediately tells her pupil that he has lost 10 minutes of recess. What does the teacher need to do to make this consequence effective?	Alternatively, this question assesses synthesis through providing a novel situation to be analyzed and asking students to propose a solution to the problem at hand. As argued above, synthesis related to metacognition.
Comprehension 2 references coded [33,03% Coverage]	• **Reference 1**: 4) A teacher has given a presentation where he demonstrated how to improve writing skills. One of his students seems to be very excited about improving these skills. He also seems to pay attention to all the tips the teacher demonstrated and remembers every detail in the presentation. But he thinks that he doesn't have the skills the teacher has and that these are not the tips he would be able to apply. In the light of the social learning theory, explain what both the teacher and the student did in this scenario. • **Reference 2:**	Through presenting novel situations and asking for explaining certain ideas presented in reference 1 and 2, students comprehension in assessed. What stands out, perhaps, is the lengthy situations presented along with the questions. Clearly, students' analytical skills are called upon to decipher the information and then infer meaning, unlike when they are presented by concise, straightforward situations.

	5) At the start of first grade in primary school, the ringing school bell produces no fear in Amina. Each time Amina is late to class, she is punished by her teacher for her tardiness. After a period of time, Amina starts to exhibit trembling and tearfulness whenever the bell rings. Now, Amina begins to tremble and becomes tearful whenever the oven timer rings at home. What happened to Amina in both situations ?Explain using appropriate terminology.	
Evaluation reference coded [36,39% Coverage]	• **Reference 1:** 1) Underline the statement (a, b or c) that best answers each of the following questions 1- Asma is excited about returning to school after summer vacation. Her first day of middle school ended great, and once Susan is at home she begins to recall that day's events. What type of knowledge is Susan's memory of the day's events? procedural knowledge b- semantic knowledge c- episodic knowledge 2-Using the principle of successive approximation involves which of the following?	Quite surprisingly, this is the first question after examining a total of five exams which is not a short answer question. The following reference includes three multiple choice questions. In fact, this type of questions can be used to assess students' judgments to analyze and evaluate information. Evaluation necessitates a variety of high order of thinking skills (comprehension, application, analysis). To successfully make the decision to choose the right option from a list of words that share slight differences between each

	Making a succession of trials designed to provide information about a problem. Reinforcing responses that represent progress toward a desired response. Acquiring a behavior change through imitation of models demonstrating a behavior 3- A student has to memorize a list of words for a contest. Which of the following is the best strategy for the student to use to enhance recall of the words? Grouping the words according to semantic category b-Spelling each of the words c - Writing a definition of each of the words	other is for sure a challenging task. It is our assumption that these questions do assess evaluation but, at the same time, present quite general and clear concepts. Hence, analysis is not expected to be used extensively to answer such questions. Still, they can very well be related to high levels of metacognitive awareness.

What is remarkable in this exam is the fact that questions assessing knowledge does not exist at all. In addition, after examining 4 exams, this is the first one that seems to reference all high levels of understanding from comprehension all the way to evaluation. More importantly, 36% of data was coded under evaluation, the most coded data recorded in all exams as far as evaluation is concerned; this is with a great significance because evaluation encompasses many other skills like analysis and comprehension which stimulate students to alternate between these skills in order to provide correct judgments. What can also be noted is how compacted the situations that were coded under the theme of application are. As a result, students would be prompted to use their analytical skills and comprehension to understand the situations and answer the questions.

Out of 5 exams analyzed in this research, this one seems perfect to fit the characteristics of exams that require high metacognitive awareness in order to be successfully passed.

From the thorough analysis provided above, we can see that four out of five exams analyzed are highly demanding of metacognitive awareness (the case of the first, the third, the fourth and the fifth), and only one exam appears to account for average levels of metacognition (the case of the second). Nevertheless, there are mild variations in metacognitive requirements across the exams. Consequently, the hypothesis related to the fourth research question stating that "There are variations in the levels of metacognitive requirements covered in different modules." is accepted.

2.5 Findings Related to the Relationship between Metacognitive Requirements of Exams and Students' Scores in the Five Modules

Since the data is normally distributed (see Figure 6 and 7) (notice that the histogram displayed in figure 7 is roughly approximating the assumption of normal distribution), we calculated Pearson correlational coefficient to answer the fifth research question. The students' scores in the five exams were correlated with the percentages of coded data mentioned in the analysis above. As shown in Table 16, the r value (-.519) and the p value ($0.01 < \alpha = .05$) indicate a moderate negative, statistically significant relationship between the two variables.

This negative correlation provides very interesting insights; we understand that the higher the percentage of metacognitive requirements is in a module, the lower the students' scores are, which suggests that a considerable number of students possess poor levels of metacognitive awareness as opposed to what have been found in the first research question. More importantly, these findings can answer why the correlation between students' MAI scores and GPAs was weak in this study; a pleading account for this is that the participants actually possess low levels of metacognitive awareness and, for many reasons, reported inaccurate responses in the MAI. Quite plausibly, students may have had a hard time recalling strategies and techniques used in previous tasks, especially that the time gap between task performance (passing the exams) and the implementation of the measuring tool is large, which can further exacerbate the risk of reporting inaccurate beliefs. Also, due to social desirability, the participants may have felt over confident in responding to the statements and overestimated their level of metacognitive awareness. As anticipated, the last hypothesis related to the fifth research question which says "Metacognitive requirements of exams correlate negatively with students' scores" is accepted.

We hinted above at some of the threats that can jeopardize students' ability to report accurate beliefs in the MAI. In the following titles, we acknowledge other limitations and recommend how can future studies focus on some of the gaps presented in the literature taking into consideration the limitations of this study.

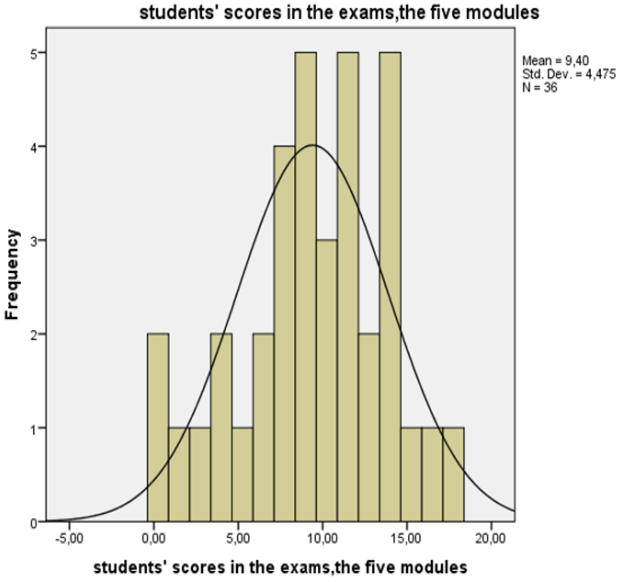


Figure 6

Histogram of Students' Scores

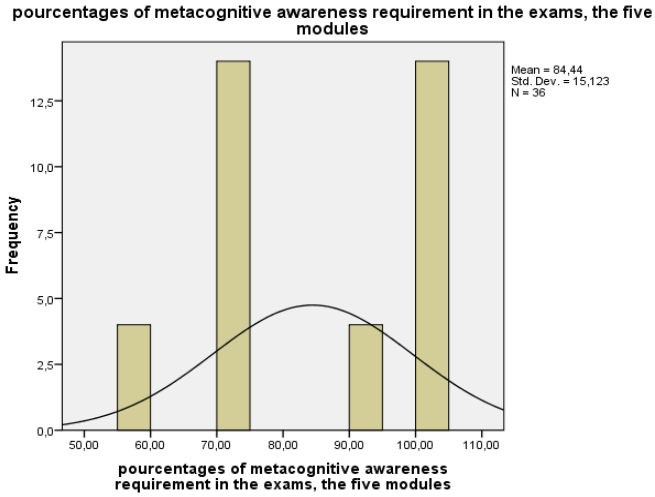


Figure7

Histogram of' metacognitive requirements

Table 16

The Correlation between Exams' Metacognitive Requirements and Students' Scores

		students' scores in the exams, the five modules	percentages of metacognitive awareness requirement in the exams, the five modules
students' scores in the exams, the five modules	Pearson Correlation	1	-,519**
	Sig. (2-tailed)		,001
	N	36	36
percentages of metacognitive awareness requirement in the exams, the five modules	Pearson Correlation	-,519**	1
	Sig. (2-tailed)	,001	
	N	36	36

**. Correlation is significant at the 0.01 level (2-tailed).

Limitations of the Study

The unprecedented breakout of COVID19 imposed many restrictions on this research, particularly when it came down to administering the questionnaire; requesting participants to answer a questionnaire with no physical interaction at all will most likely result in a low response rate. As expected, the majority of the participants dismissed our request to take part in this study. Therefore, we were obliged to substitute some participants with students outside of our sample. Still, the total response rate was 47%. Moreover, 8.6% of responses were discarded because of missing data. Clearly, this sample is not representative of the whole population.

As mentioned in the literature and in the discussion of the findings, data collected from self-report questionnaires, including the MAI, are susceptible to memory distortion

issues and social desirability. This may have prompted the participants to respond inaccurately to the statements related to the MAI.

The percentage of data covered in relation to metacognitive awareness in the thematic content analysis are not absolutely accurate. The Nvivo12 software code the language covered in a document under percentages. In some modules, several questions can be coded under multiple themes. Since it is, sometimes, insensible to detach one part of the question from another, the whole question which encompasses different levels of understanding is repeated each time under different themes. Hence these percentages are not a flawless indicator of what is measured. Moreover, the number of exam questions examined in the analysis is so limited (only five). By necessity, students' scores in these exams are not representative of their academic performance as measured by their GPA scores in the second research question.

Last but not least, it is commonsense to acknowledge that many confounding variables can interfere when conducting a correlational research. In the literature review, we highlighted one of the variables, intelligence, which was recognized by scholars to be highly likely to obscure the correlation between metacognition and academic achievement. As a matter of fact, this extraneous variable was not controlled in this study.

Recommendations

Our study did not account for investigating the correlation between the two factors of metacognitive awareness (regulation and knowledge of cognition) with academic achievement. Even though the MAI accounts for a whopping 36 statements to measure regulation of cognition factor, it was regarded as an instrument which is best suited to assess knowledge of cognition (Jacobse & Harskamp, 2012). In fact, Schraw and Dennison (1994) reported a statistically significant relationship between the MAI scores and measurements of academic achievement, but they only reported the correlation between the knowledge of

cognition factor and academic achievement and discarded the findings related to regulation of cognition. Also, we did not address the fact that the relationship between metacognition and academic achievement can change from one academic level to another, and what implications can be drawn from such inquiry. Further studies can touch on these problems to expand our understanding on the relationship between these two factors assessed by the MAI and academic achievement and how can academic level influence this relationship.

We encourage more studies to further test out thematic content analysis to investigate the metacognitive requirements of questions through accounting for a larger number of exams than the one studied in this study. This would increase the possibility of finding exams which are characterized with poor metacognitive requirements and, ultimately, draw the teachers' attention to this fact. Moreover, there is a possibility of using another self-report questionnaire reported in the first section, in addition to the MAI, to assess metacognition and compare and contrast between the findings collected from these questionnaires. This shall provide further insight on what questionnaire is more accurate in measuring metacognition.

Students also have the opportunity to further investigate the infamous argument about domain specificity and generality of metacognitive skills. The literature reveals that scholars are still torn apart between regarding metacognition as a skill that can be transferred to different academic contexts, or is merely related to a meticulous area of studies (Schraw, 2001). A research which investigates this issue may provide more details on the nature of metacognitive skills.

More studies can investigate the interference of intelligence as a confounding variable through comparing and contrasting the relationship between findings related to each variable with academic achievement. This would, in turn, contribute to the existing literature

investigating this issue and add evidence supporting one of the three models discussed in section one.

More importantly, teaching metacognitive skills promises substantial improvements in students' academic achievement as the most respected academic institutions worldwide have argued in favor of its implementation (Perry et al., 2019). Schraw (2001) have proposed several teaching strategies in order to improve students' metacognitive awareness. Researchers can conduct experimental studies to test out the efficacy of such strategies.

The rigorous analysis and thorough discussion of the findings in this chapter unraveled interesting facts. Unexpectedly, the first hypothesis formed in the beginning of this study did not live up to our expectations, and the findings related to the second and fifth research question seem to yield contradicting results. However, through discussing the findings related to the fourth and fifth research question, we have warranted in favor of the possibility that the participants' inaccurate answers in the MAI can be the main cause behind such contradiction. Along the same lines, we accounted for the limitations of this study and listed several recommendations for future research.

General Conclusion

This study is divided into two main chapters: a theoretical chapter and a practical chapter. The first chapter entails only one section. First and foremost, we paved the way for the reader to embark on the journey of understanding metacognition by providing an overview on the definitions provided by multiple scholars. Second, we devoted a considerable number of pages to discuss Flavell's conception of the term and other subsequent researchers' findings that further elaborated on his views. Third, we reserved a whole title to report Schraw and Dennison's framework of metacognition. Fourth, we reported the different methods accounting for measuring metacognition. Fifth, we weighed in on the importance of metacognition to academic achievement and exploited the findings discussed in the previous title to provide empirical evidence to support this idea. Finally, we concluded the theoretical chapter by discussing intelligence as a possible confounding variable when studying the relationship between metacognition and academic achievement.

The second chapter dealt with research methodology, data analysis and interpretation. The first section of this chapter described the sample, research methods, data collection tools and procedures. The second section accounted for analysis and interpretation of the findings. We started by answering the first, second and third research questions through presenting data generated by SPSS20 and interpreting the results. As argued above, the results revealed that the majority of students of English in Laarbi Tebessi University are highly metacognitively aware which led us to reject the hypothesis related to the first research question. Although students' GPA scores in the first semester had a weak correlation with their MAI scores, we were able to substantiate the fact that metacognitive awareness is a predictor of academic achievement. Afterwards, we displayed the findings of thematic content analysis which answered the fourth research question. As anticipated, the exams we have analyzed had varying percentages of metacognitive requirements. Then, we studied the relationship

between metacognitive requirements covered in the five exams and students' scores in the corresponding modules. The correlation coefficient yielded a moderate negative, statistically significant correlation which perfectly aligned with our hypothesis. Finally, we concluded by acknowledging the limitations of this study and calling for further researches to investigate several important concepts related to metacognition and academic achievement; the doors are wild open to dive into this area of interest and explore many things we did not discuss in this research.

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Appendices

Appendix A

Typology of Metacognitive Components (Lai,2011)

Metacognitive Component	Type	Terminology	Citation
Cognitive knowledge	Knowledge about oneself as a learner and factors affecting cognition	Person and task knowledge	Flavell, 1979
		Self-appraisal	Paris & Winograd, 1990
		Epistemological understanding	Kuhn & Dean, 2004
		Declarative knowledge	Cross & Paris, 1988 Schraw et al., 2006 Schraw & Moshman, 1995
	Awareness and management of cognition, including knowledge about strategies	Procedural knowledge	Cross & Paris, 1988 Kuhn & Dean, 2004 Schraw et al., 2006
		Strategy knowledge	Flavell, 1979

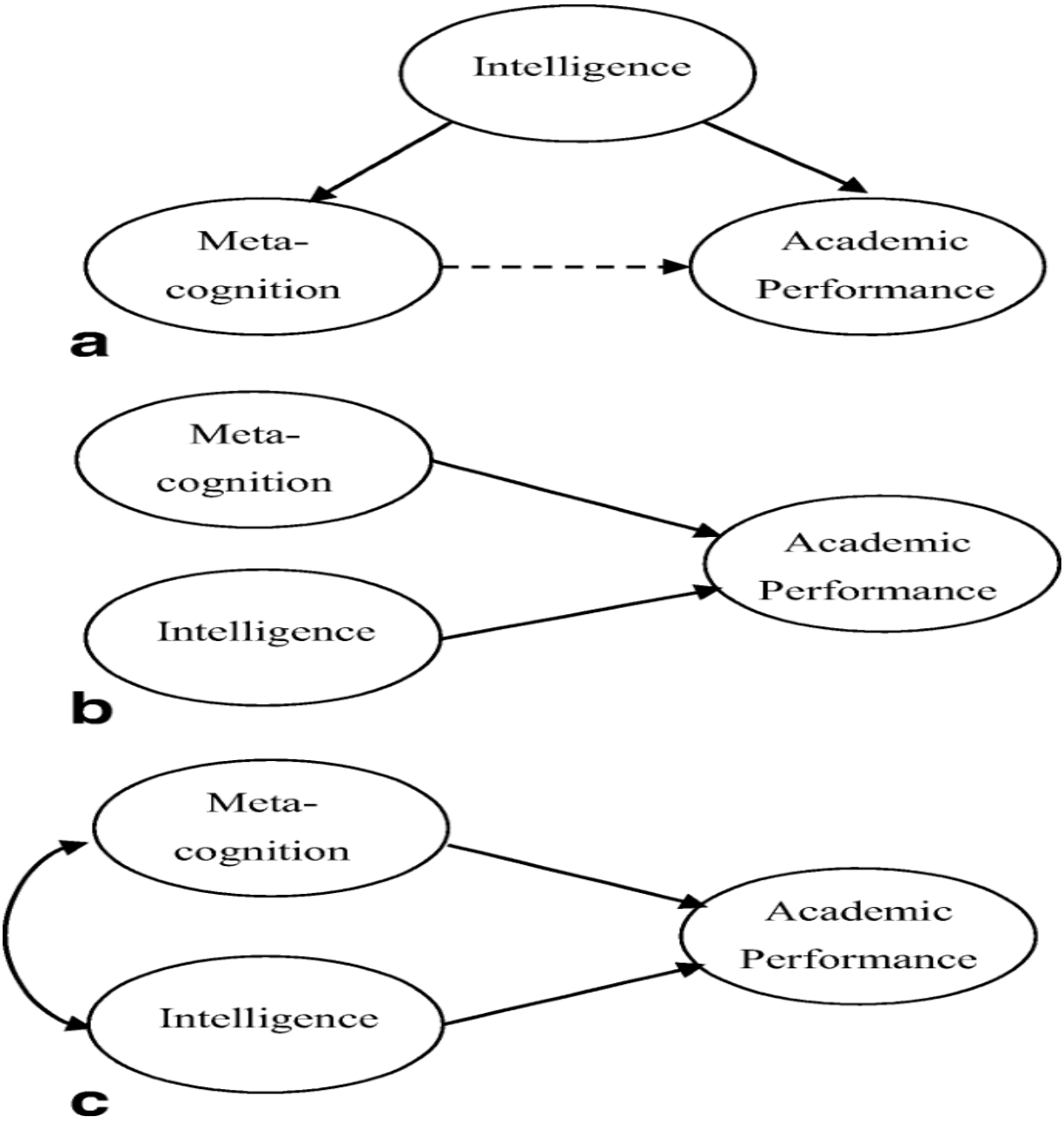
	Knowledge about why and when to use a given strategy	Conditional knowledge	Schraw et al., 2006

Cognitive regulation	Identification and selection of appropriate strategies and allocation of resources	Planning	Cross & Paris, 1988 Paris & Winograd, 1990 Schraw et al., 2006 Schraw & Moshman, 1995 Whitebread et al., 2009
	Attending to and being aware of comprehension and task performance	Monitoring or regulating	Cross & Paris, 1988 Paris & Winograd, 1990 Schraw et al., 2006 Schraw & Moshman, 1995 Whitebread et al., 2009
		Cognitive experiences	Flavell, 1979

	Assessing the processes and products of one's learning, and revisiting and revising learning goals	Evaluating	Cross & Paris, 1988 Paris & Winograd, 1990 Schraw et al., 2006 Schraw & Moshman, 1995 Whitebread et al., 2009

Appendix B

The hypothesized relationships among the three variables. a The intelligence model represents metacognition as a manifestation of intelligence. b The independence model shows that both predictors are orthogonal. c The mixed model demonstrates the correlation between the predictors and shows that they are significant predictors of academic performance



Appendix C

The adapted version of the MAI

Student Name

Level

Metacognitive Awareness Inventory

The following questionnaire aims at measuring students' level of metacognitive awareness. We appreciate your time and efforts in filling this questionnaire which is totally voluntary. We assure you that your identity information is needed only for the sake of the research and will remain confidential. Say to what extent each of the following statement applies to you. Make sure to tick only one box for each statement to rate your answers from 1 = Not at all typical of me, 2 = Not very typical of me, 3 = Somewhat typical of me, 4 = Fairly typical of me, and 5 = Very typical of me. Your answers will be of great importance to the research findings, so try to be as honest as possible.

Statements	Not all typical of me	Not very typical of me	Somewhat typical of me	Fairly typical of me	Very typical of me
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.					
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 analysing 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.					
36. I ask myself how well I accomplish my goals once I'm finished.					
37. I draw pictures or diagrams to help me understand while learning.					

38. I ask myself if I have considered all options after I solve a problem.					
39. I try to translate new information into my own words.					
40. I change strategies when I fail to understand.					
41. I use the organizational structure of the text to help me learn.					
42. I read instructions carefully before I begin a task.					
43. I ask myself if what I'm reading is related to what I already know.					
44. I re-evaluate my assumptions when I get confused.					
45. I organize my time to best accomplish my goals.					
46. I learn more when I am interested in the topic.					
47. I try to break studying down into smaller steps.					
48. I focus on overall meaning rather than specifics.					
49. I ask myself questions about how well I am doing while I am learning something new.					
50. I ask myself if I learned as much as I could have once I finish a task.					
51. I stop and go back over new information that is not clear.					

52. I stop and reread when I get confused.					

Appendix D

Loading items of the MAI

Item	Factor 1	Factor 2
32	.70 (.69)	.00 (.00)
26	.66 (.52)	.00 (.00)
5	.65 (.43)	.00 (.00)
30	.59 (.59)	.00 (.00)
45	.57 (.30)	.00 (.00)
10	.56 (.72)	.00 (.00)
13	.55 (.66)	.00 (.00)
3	.55 (.54)	.00 (.00)
29	.54 (.35)	.00 (.00)
16	.53 (.51)	.00 (.00)
15	.53 (.41)	.00 (.00)
9	.51 (.36)	.00 (.32)*
20	.51 (.37)	.00 (.00)
52	.48 (.00)*	.00 (.00)
33	.48 (.57)	.00 (.00)
12	.46 (.65)	.00 (.00)
18	.43 (.00)*	.00 (.39)*
17	.42 (.57)	.00 (.00)
7	.41 (.41)	.00 (.00)
51	.40 (.00)*	.00 (51)*
39	.38 (.00)*	.00 (.00)
45	.38 (.32)	.00 (.00)
25	.34 (.00)	.00 (.00)
31	.34 (.30)	.00 (.00)
42	.31 (.38)	.00 (.00)
22	.00 (.00)	.70 (.52)
36	.00 (.00)	.70 (.67)
8	.00 (.00)	.68 (.55)
50	.00 (.00)	.65 (.00)*
38	.00 (.00)	.62 (.64)
1	.00 (.00)	.62 (.45)
23	.00 (.00)	.60 (.63)
6	.00 (.00)	.59 (.44)
49	.00 (.00)	.55 (.55)
21	.00 (.00)	.55 (.00)*
24	.00 (.00)	.52 (.34)
28	.00 (.00)	.50 (.31)
11	.00 (.00)	.46 (.43)
14	.00 (.00)	.46 (.40)
19	.00 (.00)	.44 (.36)
47	.00 (.30)*	.39 (.00)*
37	.00 (.00)	.38 (.34)
2	.00 (.00)	.36 (.58)
41	.00 (.00)	.32 (.30)

27	.42 (.35)	.37 (.00)*
43	.37 (.41)	.37 (.00)*
44	.34 (.00)*	.41 (.49)
34	.34 (.40)	.36 (.32)
40	.34 (.41)	.30 (.00)*
35	.31 (.36)	.43 (.41)
4	.00 (.00)	.00 (.00)
48	.00 (.00)	.00 (.00)

*Indicates differences in loadings across Experiments 1 and 2.

Appendix E

1. Code Book

1.1 Operational Definition of the Themes

Knowledge: this is the lowest level of understating reported by the CRESST (as stated in Clay, Root, 2001). Knowledge is related to verbatim recall and retrieval of memorized information. It is called verbatim because there is no actual manipulation of the information before solving a given task; students would answer question that evaluate knowledge through retrieving knowledge word by word (Bloom, 1956).

Comprehension: Comprehension goes beyond mere memorization of information. Rather, it reflects the extent to which students grasped the learned material. Thorough and deep understanding of concepts are critical for mastering comprehension (Bloom, 1956).

Application: Application is concerned with applying a wide variety of learned materials (methods, theories, concepts, rule of thumb…etc.) in new situations. It is the appropriate manipulation and transfer of knowledge to solve novel problems (Bloom, 1956).

Analysis: This refers to the act of scrutinizing the details related to learned material, breaking down of information into small components, and establishing relationships between these components. By necessity, this level of understanding requires the mastery of comprehension (Bloom, 1956).

Synthesis: Synthesis means the ability to produce or create answers in novel situations. This level of understanding usually appears in questions which require students to create, suggest or produce an answer based on the instructions of the questions and background knowledge. Many other levels of understating are embedded in synthesis like comprehension and application (Bloom, 1956).

Evaluation: Evaluation is the highest level of understanding reported by the CRESST (as stated in Clay, Root, 2001). It entails judging the validity of learned materials based on definite criteria. More importantly, many high levels of understating are mandatory for proving a correct judgement like comprehension, analysis and application (Bloom, 1956).

1.2 Key Words Related to each Theme and their Objective (Bloom, 1956).

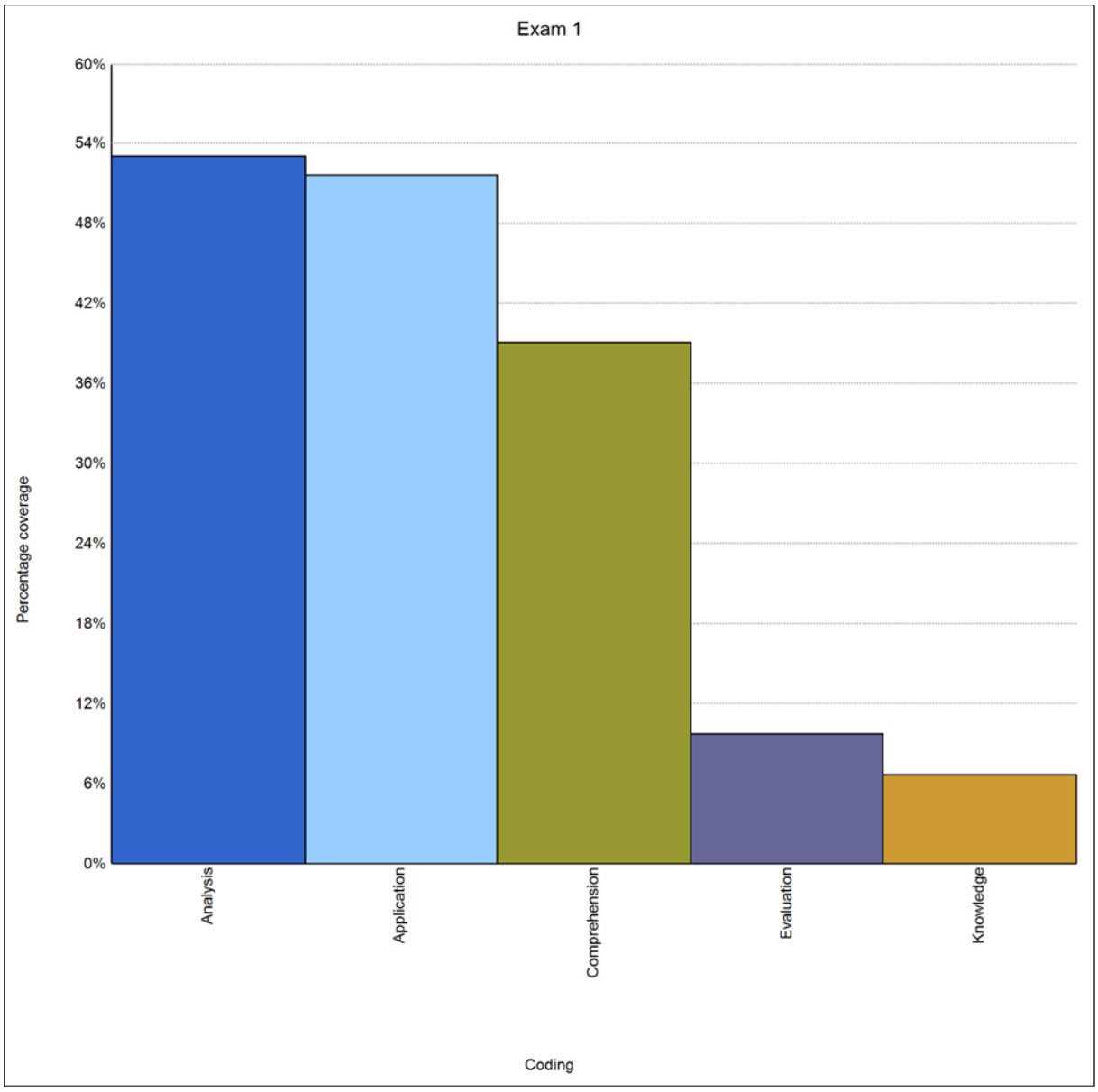
Level of understanding	**Knowledge**	**Comprehension**	**Application**	**Analysis**	**Synthesis**	**Evaluation**
Key words associated with each level	Define , List, mention.	Explain	The are no specific key words which indicate applications. Rather, any question which requires answering questions based on analyzing novel situation	Justify, Why-questions	Create, write, suggest, use, think, add	Choose, evaluate, what-do-think questions, do-you agree questions
Objective of each level	Knowing specific facts.	Explaining specific concepts	Applying knowledge to novel situations	Providing sound and reliable arguments	Testing the ability to write well-structured and organized answers	Testing the ability to use other levels of understudying to judge the validity of information

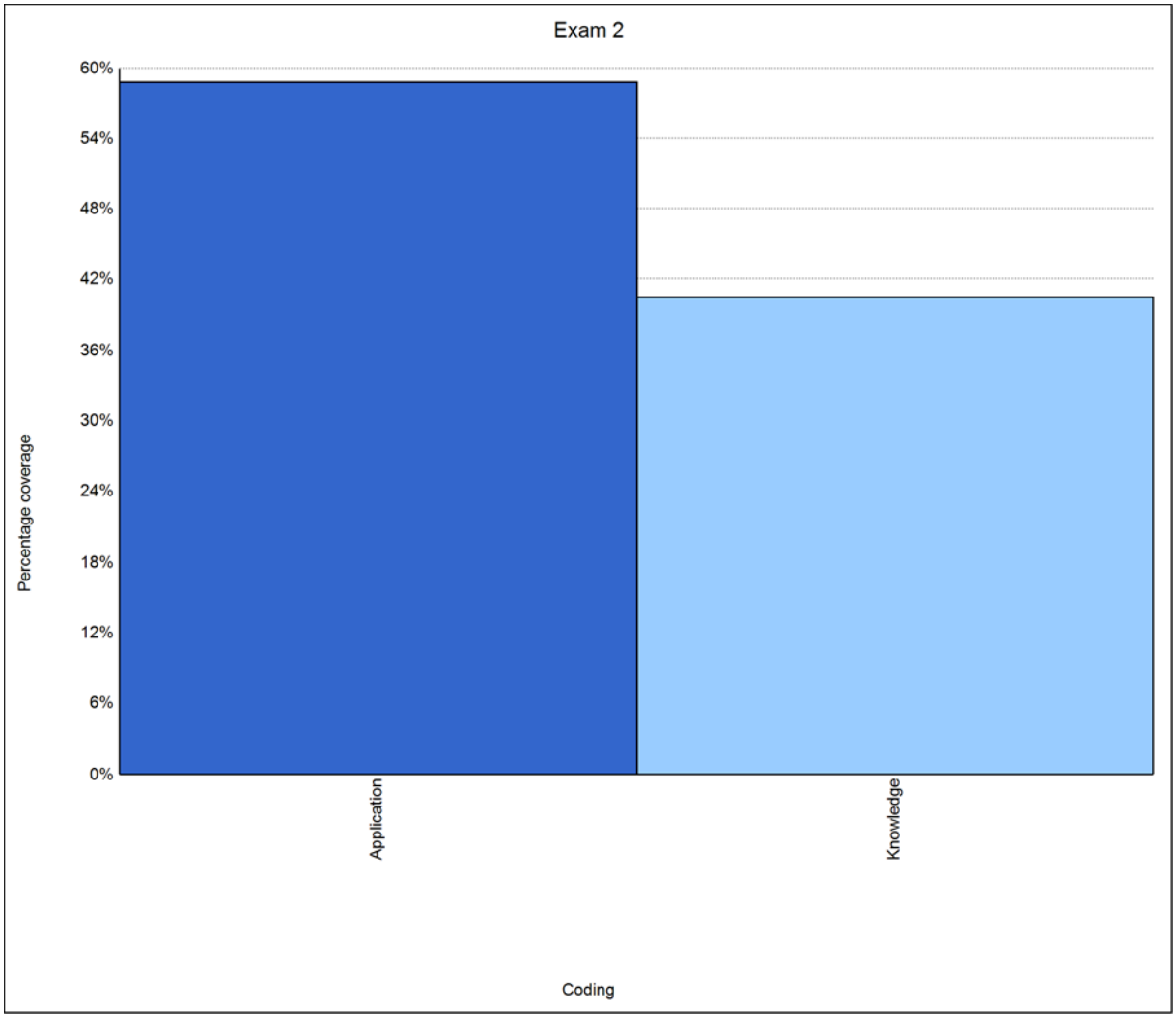
1.3 Procedures related to coding

We depended on spotting the key words mentioned in the table above to classify each question under the corresponding themes. We divided questions that are complex into sub questions and followed the same technique in their classifications.

Appendix F

Charts of coding data related to metacognitive requirements in the five modules




Exam 2
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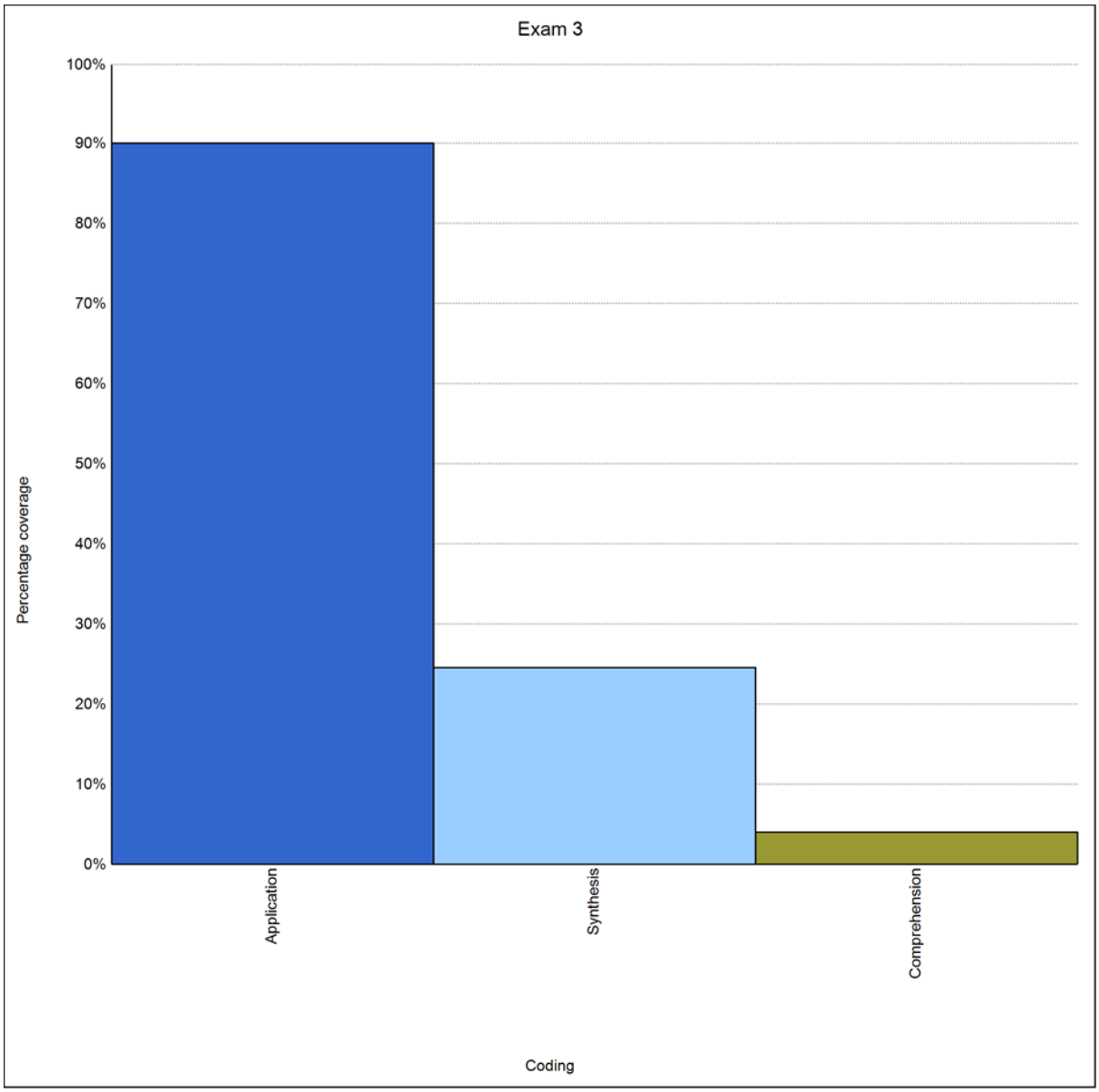
Percentage coverage
Application
Knowledge
Coding


Exam 3
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Application
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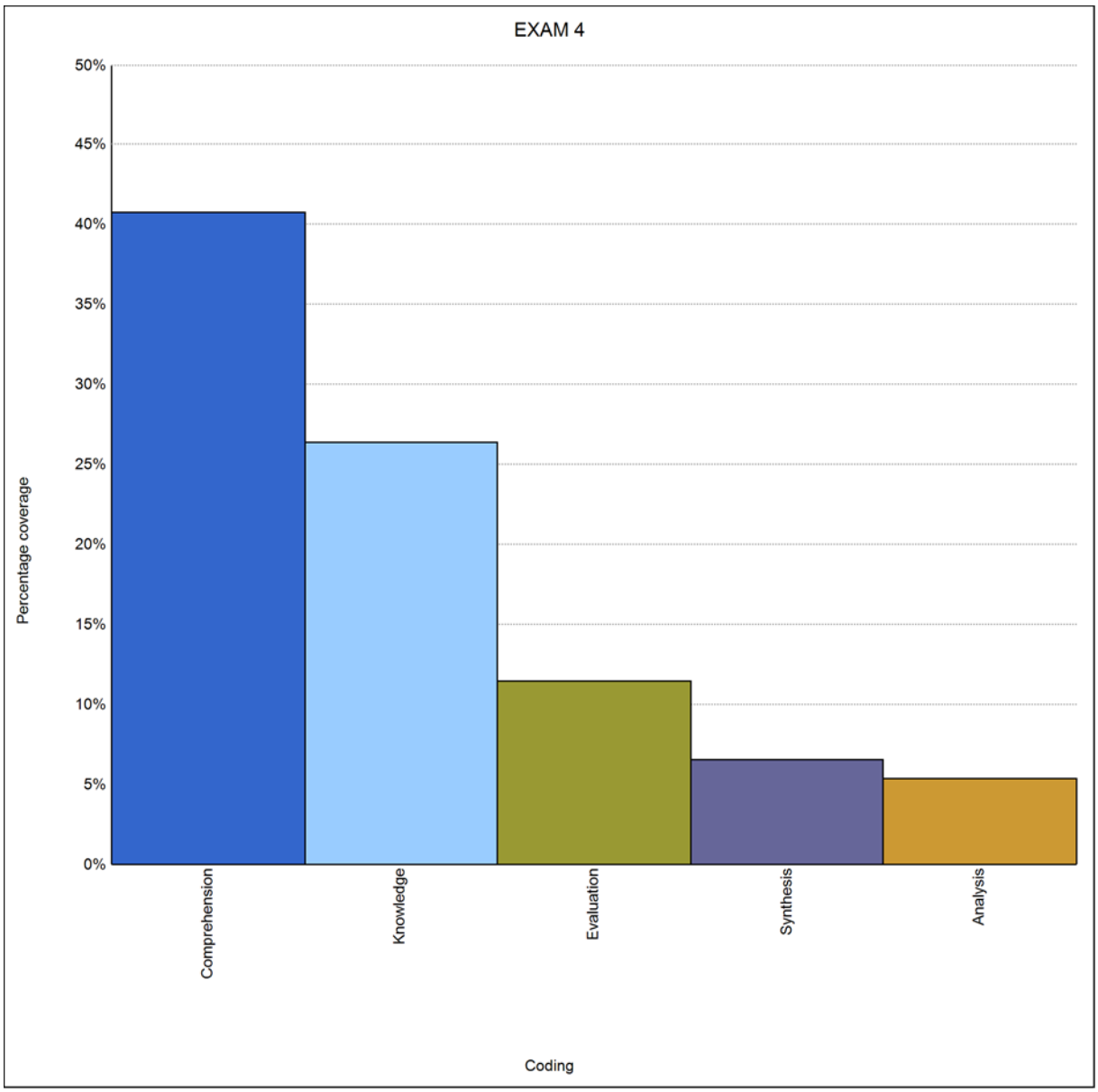
Comprehension
Coding


EXAM 4
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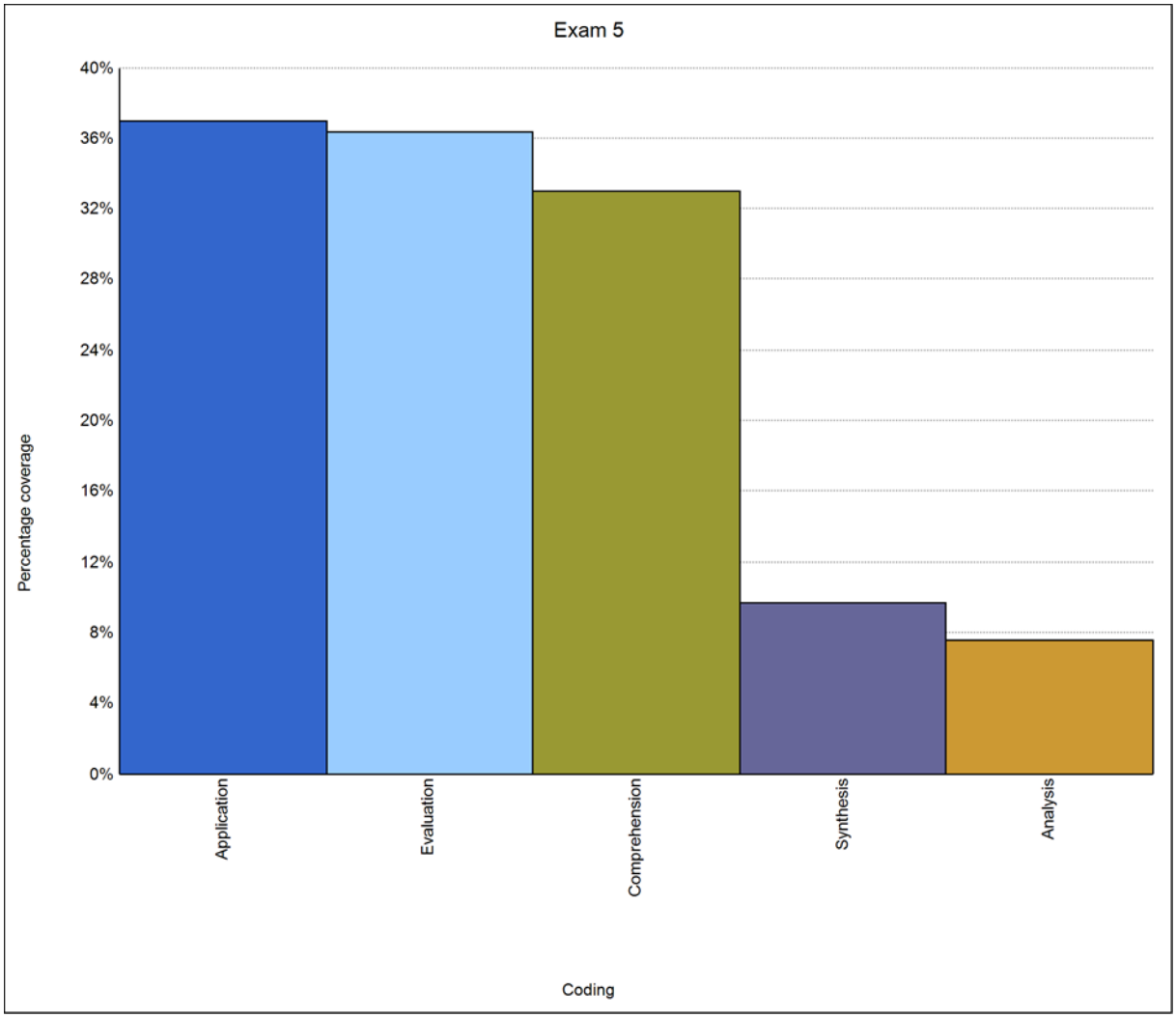
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Synthesis
Analysis
Coding

Résumé

En constatant les différences frappantes entre les notes des étudiants dans les différents domaines d'études au cours des quatre dernières années, nous avons décidé de nous lancer dans une enquête sur les raisons de ces variations et de comprendre ce qui peut être fait pour améliorer les résultats scolaires des étudiants. L'étude actuelle tente d'explorer la relation entre la conscience métacognitive et les résultats scolaires des étudiants de l'Université Laarbi Tébessi au département de langue anglaise. L'échantillon cible est composé de 70 étudiants (16 hommes et 54 femmes) et a été choisi au hasard parmi les étudiants de deuxième et troisième année de licence, de master un et deux, spécialité en sciences du langage. Pour répondre aux questions de recherche, nous avons utilisé une enquête et une méthode corrélationnelle, en plus de la technique d'analyse de contenu. Les résultats révèlent que les étudiants possèdent un niveau élevé de conscience métacognitive qui est en corrélation positive avec leurs résultats de la moyenne générale. De plus, la conscience métacognitive semble être un prédicteur de la réussite scolaire, et les examens analysés présentent différents pourcentages d'exigences métacognitives qui, à leur tour, sont en corrélation négative avec les résultats des élèves à ces examens. Ces résultats sont suffisamment intéressants pour attirer l'attention des enseignants et des directeurs d'école sur le fait qu'il est très important d'enseigner les compétences métacognitives en classe.

الملخص

من خلال ملاحظة للاختلافات الصارخة في درجات الطلاب في مجالات الدراسة المختلفة على مدار السنوات الأربع الماضية، قررنا الشروع في التحقيق في أسباب هذه الاختلافات وفهم ما يمكن فعله لتحسين الدرجات النتائج الأكاديمية للطلاب. تحاول الدراسة الحالية استكشاف العلاقة بين الوعي ما وراء المعرفي والأداء الأكاديمي للطلاب في جامعة العربي التبسي في قسم اللغة الإنجليزية. تتكون العينة المستهدفة من 70 طالباً (16 رجلاً و54 امرأة) وتم اختيارهم عشوائياً من طلاب السنة الثانية والثالثة ليسانس بالإضافة الى سنة الأولى والثانية تخصص علوم اللغة. للإجابة على أسئلة البحث استخدمنا طريقة المسح وطريقة الارتباط بالإضافة إلى تقنية تحليل المحتوى. تكشف النتائج أن الطلاب يمتلكون مستوى عالٍ من الوعي ما وراء المعرفي الذي يرتبط بشكل إيجابي بدرجاتهم الأكاديمية. بالإضافة إلى ذلك، يبدو أن الوعي ما وراء المعرفي مؤشر على التحصيل الأكاديمي، والامتحانات التي تم تحليلها تظهر نسبًا مختلفة من المتطلبات وراء المعرفية والتي بدورها ترتبط سلبًا بأداء الطلاب في هذه الاختبارات. هذه النتائج مثيرة للاهتمام بما يكفي لجذب انتباه المعلمين ومديري المدارس إلى حقيقة أنه من المهم جدًا تعليم المهارات ما وراء المعرفية في الفصل الدراسي.