Impact of a Cognitively Modified Instruction on Vocabulary Acquisition of Second Language Users of Grade 2: A study conducted in a private American school in Dubai

أثر التعليمات المعدلة معرفياً على عملية اكتساب المفردات لدى طلاب الصف الثاني من مستخدمي اللغة غير بها الناطقين : دراسة تم إجراؤها في مدرسة أمريكية خاصة في دبي

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Abstract

Human cognition is structured to automatically build schemas when learning is presented in a systematic way. Taking care of element interactivity during the instructional planning can help reduce the cognitive load of learning. For a teacher who is passionate to deliver effective instruction, it is not only achievable but also exciting. Carefully designed instruction is needed to ensure that the cognitive load taken by the learner matches his or her working memory capacity. This is a complex process and needs to be individualized for every learner.

This experimental study is inspired by Sweller's Cognitive Load Theory which originated in 1980s. The main studies of CLT have been conducted in the field of Mathematics and Media Learning. The current study, however, explores its application in the field of English as a second language acquisition. The study was conducted to find the impact of modified instructional strategies that help reduce the cognitive load. Specific instruction was tailored using principles of split-attention effect, modality effect, and redundancy effect. This resulted in a reduced cognitive load for the learner, which helped increase the performance of grade 2 (7 years old) students in vocabulary and comprehension acquisition. Deviation method was used to analyse the impact of modified instruction on students' performance. Efficiency metric showed that students in experiment group demonstrated better efficiency as compared to the control group. Lesson observations were conducted to validate the delivery of the instruction as per the design. The findings of the observation reflected a higher level of student engagement. The study concludes that modified instruction with reduced cognitive load results in increased performance of the learners of the English as a second language.

البحث ملخص

إن الإدراك البشري مجهّز لإنشاء مخططات تلقائية عند تقديم عملية التعلم بطريقة منظمة. و يساعد الإهتمام بتفاعل العناصر خلال التخطيط للتعليمات على التقليل من العبء المعرفي لعملية التعلم. و لا يعد ذلك بالأمر الممتع فحسب و إنما سهل المنال أيضاً لأي مدرّس يسعى لتقديم تعليمات ناجحة. و تعتبر التعليمات المعدّة بإتقان ضرورية لضمان توافق العبء المعرفي للمتعلمين مع قدرة الذاكرة الفاعلة لديهم. و تحتاج عملية معقدة كهذه لأن تكون ذات صبغة فردية لكل متعلم.

إن هذه الدراسة التجريبية مستوحاة من نظرية العبء المعرفي لـ (سويلر) و التي نشأت في ثمانينيات القرن العشرين. و كانت الدراسات الرئيسة في هذه النظرية تُعنى بالرياضيات و الدراسات الإعلامية غير أن الدراسات الحالية تبحث في تطبيق النظرية في مجال تعلم اللغة الإنكليزية كلغة ثانية. و تركز الدراسة على إيجاد أثر استراتيجيات التعليم المعدلّة التي تساعد على التخفيف من وطأة العبء المعرفي. و تم تصميم تعليمات معينة بإستخدام مبادئ تأثير انقسام الإهتمام و تأثير الشكل إضافة إلى تأثير الإطناب، فأدّت النتائج إلى توفير عبء معرفي مخفف للمتعلمين، و بالتالي تحسين أداء طلبة الصف الثاني (7 سنوات من العمر) في اكتساب المفردات و القراءة و الفهم. كما استُخدمت الطريقة التباينية لدراسة و تحليل أثر التعليمات المعدلة على تطور الطلبة. و قد أظهرت مصفوفة الكفاءة أن الطلبة في المجموعة أجريت عليها الدراسة كانوا أكثر كفاءة مقارنةً بالمجموعة التي تمت مراقبتها. هذا و قد تم إجراء دروس مشاهدة للتحقق من إيصال التعليمات وفقاً لما تم التخطيط له. و تعكس نتائج دروس المشاهدة مستوىً عالٍ من المشاركة لدى الطلبة. و من خلا هذه الدراسة نستنتج أن التعليمات المعدلة للتخفيف من العبء المعرفي تؤدي إلى تحسين أداء متعلمي اللغة الإنكليزية كلغة ثانية.

Dedication

To every soul that is passionate to learn

To my dear husband, for all his support at every step

To my brother who is part of my soul

To my mentor, Clifton Chadwick

Acknowledgement

To begin with, uncountable thanks to Allah Almighty for blessing me so much that I cannot thank Him enough, even if I try it every day.

Thanks to my dear parents for all their love, trust, and sacrifices in making me who I am today.

My utmost gratitude for my mentor, Dr Clifton Chadwick (May his soul rest in peace), who has taught me skills that I will be proud to own and utilize for the rest of my life. I only wish that he was alive to read this work! Thank you for every word of encouragement that gave me confidence to face challenges and every criticism that made me learn and grow. The confidence that I have to face the world today, I owe it to you.

A 'thanks' is a small word to acknowledge the support and guidance that Dr Solomon Arulraj David has extended throughout my study time. His look with "I will ask a lot of questions" challenged me not to let him have asked many questions. I just tried!

Thanks to my siblings, who always encouraged me (especially by checking on how many words had I written on daily basis) and have trusted me that I will do better than my best. Special thanks to Nasira, and Shagufta for proof reading my work and providing critical advice.

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List of Acronyms

ADEC	Abu Dhabi Education Council
CLT	Cognitive Load Theory
DSIB	Dubai School Inspection Bureau
E	Efficiency
KHDA	Knowledge and Human Development Authority
LTM	Long Term Memory
ME	Mental Effort
MoE	Ministry of Education
P	Performance
SPSS	Statistical Package for Social Sciences
TXL	Task Load Index
WM	Working Memory
ZPD	Zone of Proximal Development

Chapter 1 Introduction

1.1 Overview

"How do we learn what we learn?" this must be the question in the minds of many philosophers who have always been trying to find out how does human brain work to learn (Fagin et al. 2003). Human brain is very intricate (Long 2000). This intricacy has always attracted many philosophers and researchers. The way human brain is programmed to learn and process knowledge and information, has been an explorable question for educational psychologists. They have always tried to look for the answer of how the mind processes information and what can accelerate this process further. Human brain is no less than a computer with a chip that processes information in seconds and stores it. It is programmed by default to learn information (Long 2000). Brain is a store house of information; schemas are information blocks that assimilate and accommodate information, explains Slavin (2014, p. 34, 35) while referring to Piaget. The information has to be processed in a systematic way so that schemas are built automatically. Any disruption in information processing can have a detrimental effect on the building of schemas resulting in learning difficulties. If these difficulties are not handled systematically, these can create gaps in learning.

Research has concluded that competence is built and cognitive activity is forwarded by the adult as well as the context surrounding the adult (eds Raynolds & Miller 2003). It is the mind and the environment that work together to make learning happen. The current study is driven by the similar principle. The human brain experiences cognitive load during the process of learning. Learning can be maximized if the cognitive load is reduced. If brain goes through the unnecessary load during learning process, it not only slows learning down but also affects learner's motivation to learn. On the other hand, if the cognitive load is reduced, it accelerates learning. The cognitive load can be reduced by designing instruction in various ways that support and maximize learning. This also motivates the learner further, thus enabling the learner to acquire more knowledge and skills.

1.2 Statement of the Problem

All the research in education has been aimed at discovering and proposing ways where learner can be facilitated to maximize learning. The major goal of every school is to enable students to succeed in learning and achieve their full potential to become independent

learners. If the way human mind learns is unknown, the effort to design the instruction fails as it will not result in helping the child as expected (Schnotz & kurschner 2007; Sweller, Ayres & Kalyuga 2011). Students struggle to learn an additional language which is different than their first language. Making the process of language learning easier for the students is very important, so that they can perform better in other content areas too. The current study aims at finding the effect of an instruction that is designed to reduce the cognitive load of the learners in vocabulary learning. The process of English language learning is not easy for the learners with Arabic as first language (Moussa 2008). The unsuitable choice of instructional methods for the language learners can impede learning. Lack of appropriate instructional methods for language learning can impose cognitive load on learner thus slowing down the process of language learning. It is, therefore, essential that instruction is designed that will reduce the cognitive load. Reduced cognitive load will facilitate the learning process and enable the learner to acquire more. It will also enable the students to acquire most skills that will help them perform better.

1.3 Motivation of the Study

In the quest to help learners with appropriately designed instruction, knowing the human cognitive architecture helps a lot. Sweller, Ayres and Kalyuga (2011) emphasized on the need to know the architecture of human cognition so that a modified method of instruction can be classified as more effective than a traditional one, based on solid evidence. Cognitive load theory (CLT) is based on "aspects of human cognitive architecture that are relevant to instruction along with the instructional consequences that flow from the architecture" (Sweller, Ayres & Kalyuga 2011). CLT categorizes the knowledge in order to find out how human cognition works in order to learn. Geary as outlined in his 2008 work, (cited in Sweller, Ayres & Kalyuga 2011) has made an attempt to categorize knowledge as biologically primary and biologically secondary knowledge. According to him, biologically primary knowledge can be learnt but not taught whereas biologically secondary knowledge can be learnt as well as taught. This categorization further helps to find out how the human cognitive architecture works to acquire knowledge. Once it is known, the learner can be further facilitated by designing proper and relevant instruction. The possibility that instruction can be designed to maximize learning is very fascinating.

The study aims to find out if the learning is accelerated and maximized when learners are exposed to specifically designed tasks that reduce the cognitive load. The learning here is specific to vocabulary acquisition and reading comprehension skills.

1.4 Aims and Objectives

The main objective of the research is to find out impact of cognitively modified instruction on student learning. The following related objectives will be discussed.

i. To find certain ways of taking into consideration the element interactivity of the task assigned to the learners of English as a second language
ii. To reach a conclusion regarding which method of instruction adopted was well responded to by the students
iii. To determine the importance of vocabulary learning for better reading and understanding of a text for a second language learner

1.5 Research Questions

The research is mainly concerned with reducing the cognitive load during the instructional process so that students can be better facilitated to acquire vocabulary skills. The research aims to find the answer to the primary question:

How will cognitively modified instruction impact the vocabulary acquisition of grade 2 students with Arabic as first language?

The research will also find the answers to the following secondary questions.

i. Will students' overall subject achievement increase if they understood instruction better?
ii. Will better acquisition of vocabulary help students improve their comprehension skills?

1.6 Significance and Relevance of the Study

Learning is a fundamental right of every human being in general, and every child in particular. Every child deserves to succeed academically. All over the world, the only aim educational institutions desire to achieve is excellence through student performance (Cooper 1998). This comes through the students' success only. There are organizations established to ensure that schools perform at a level that would ensure success of most of the student population. Speaking of UAE, the Dubai Schools Inspection Bureau (DSIB) conducts annual inspection of all the private schools in Dubai to evaluate their performance. The major criteria to determine the success of the schools is students' progress and attainment. Similar is

the responsibility of Ministry of Education (MOE), and Abu Dhabi Education Council (ADEC).

Students can perform better if they are taught in a way that they attain the most knowledge. Instructional design plays a significant role in students' learning and their success. This is the reason why every school takes a great care to design instruction. The way this instruction is delivered in the classroom also impacts students' learning. Students' learning will be impacted if the instruction will impose extra load on cognition (Kirschner 2002). This is the reason why institutions all over the world aim at hiring qualified teachers and spend a lot of money on teacher training. Both factors, instructional design and delivery of the instruction, need to work in harmony to impact students' learning.

As mentioned earlier, biologically primary knowledge is acquired without much effort being consciously put by the learner. Learning the first language is an example of biologically primary knowledge. A child is not taught how to use the movement of tongue or mouth to speak or how to process the information he listens to. Biologically secondary knowledge however needs to be acquired. If learning to listen and speak in the first language of a person is part of natural learning, reading and writing are not. These skills should be taught and learnt in order to excel at these skills. In contrast to biologically primary knowledge, biologically secondary knowledge is acquired with conscious effort (Geary 2008). Geary (2007, p. 43) clearly states that "most children will not be sufficiently motivated nor cognitively able to learn all of secondary knowledge needed for functioning in modern societies without well organized, explicit and direct teacher instruction." This emphasizes on the need to have a carefully designed instruction, where the child is exposed to tasks that are simple and then build on to more complex ones.

To acquire biologically secondary knowledge, human brain goes through cognitive loads (explained in chapter 2). CLT brings forward the theory that if the cognitive load is reduced for the learner, the acquisition of knowledge becomes better. The reduced cognitive loads help build schemas which help in automate learning (Pass, Renkl & Sweller 2003).

The research is conducted on grade two students of a UAE school with American curriculum, whose first language is Arabic. The target language is English where it is second language of all students. It will be observed that what impact the instruction will have on students' performance if it is designed to reduce the cognitive load during learning.

1.7 Hypothesis

The research is carried out to test the hypothesis that if the instruction in class is designed to help students acquire vocabulary skills while the cognitive load is reduced during the learning process, it will result in improved performance (Cooper 1998). The control and experiment groups will take pre and post-tests to analyse the difference in performance. It is expected that the experiment group will show better performance in the post-test as compared to the control group.

1.8 Assumptions

The assumptions made in the study are that the experiment and control group, in regular classroom setting are taught in similar way. This is assumed so because the lesson plans and activity details are shared by all the teachers and accommodations made to suit the needs of individual class are very minor. This will allow to examine the effect of modified instruction on the control group. The teachers teaching both sections of the same grade level (control and experiment group) are qualified class teachers. The current level of the students is taken into consideration and it is expected that students are capable of reading simple texts, and know how to use dictionaries.

1.9 Structure of the Thesis

The study comprises of five chapters where chapter one outlines the introduction giving a brief insight into research questions, purpose, motivation, significance, and assumptions of the study.

The second chapter outlines key concepts that constitute the essentials of the study and gives an in-depth analysis of the past studies conducted that helps strengthen the researchers' argument. The development of the methods pertaining to the research data collection and specific essential measurements tools is also analysed. The overview of previous studies and their relation to the study is explained in the chapter.

The third chapter outlines the research design of the study. The research method, research sample, and data collection methods are explained and analysed in detail. This chapter also addresses the ethical issues of the research. It also explains limitations and delimitations of the research.

The fourth chapter is a critical analysis of the results and findings of the research. The quantitative and qualitative data is analysed. The analysis is carried out in response to the research questions.

The fifth chapter concludes the study. The key findings are discussed. Implications of the study are represented and suggestions for further study are given.

Chapter 2 Literature Review

2.1 Introduction

Language learning for a second language user has completely different cognitive demands as compared to the first language users. Language learning is a complex task and instructors and instructional designers have always attempted to make it easier for the learner through the use of various resources (Moussa 2008). Cognitive load theory helps the instructional designers to facilitate learning for the students. Based on the human cognitive architecture, the CLT has a scientific approach towards the learning and instructional design. In this chapter, first the conceptual framework will be discussed to develop a better understanding of CLT.

2.2 Conceptual Framework

2.2.1 Cognitive Structure: The Two Memories

The working memory (WM) and long-term memory (LTM) are key elements of human cognitive structure (Sweller, Ayres & Kalyuga 2011). The study of early literature brings to attention Miller's (1956) postulation that human working memory has the capacity no more than holding seven (plus or minus two) "chunks of information". Working memory has limited capacity and depends on LTM to perform complex thinking. Van Merriënboer and Sweller (2005) restate that working memory has a capacity to store seven elements but it operates on less. Sternberg and Pretz (ed. 2005, p. 19) and Pass, van Gog and Sweller (2010) summarize that working memory has been emphasized as "a pervasive component of reasoning" by modern theories of cognition. WM plays essential role in holding more than one piece of information and passing on this information to the LTM. This coordination of two memories enables us "to create novel information, remember that information, use information to govern our activities and ……. disseminate information" (Sweller, Ayres & Kalyuga 2011, p. 16). A lot of discussion and debate had been generated to gauge the capacity of human memory. It can be concluded that WM is active memory and plays major role in processing information, but cannot store information. It helps build schemas which are stored in LTM. Long-term memory is knowledge repository as WM has little storage capacity. WM carries out conscious processing of information. If the information is beyond the limited capacity of WM, it is not processed. Research also proves that LTM has unlimited capacity and the complex learning takes place in LTM (Clark, Nguyen & Sweller 2006; Krischner 2002; Sweller, van Merriënboer & Paas 1998).

2.2.2 The Knowledge

To understand the human cognition better, it is essential to understand how knowledge is categorized (Sweller, Ayres & Kalyuga 2011). As discussed in chapter 1, knowledge is bifurcated into biologically primary and biologically secondary knowledge. Biologically primary knowledge is learnt and not taught. This knowledge helps us respond to our environment. The long-term memory contains biologically primary knowledge. As we grow, we acquire biologically primary knowledge without much conscious effort because we have evolved to do so as humans. Sweller, Ayres and Kalyuga (2011, p. 18) explain this through an example. They state that when we listen or speak, we depend on the massive store of biologically primary knowledge in LTM, and because of this information stored; we can navigate in our physical world without much effort. We can respond to many situations, and do not need a lot of learning or training because of the massive information stored in the LTM. In contrast, if we have to perform a complex task, we need to acquire the knowledge to do so. Since humans have not evolved to acquire the biologically secondary knowledge, it needs to be taught and learnt. To further master skills, practice and exposure to complex tasks is required. Novice learners cannot perform tasks at expertise level until they are exposed to certain environment to help them build the schemas that are needed to master those skills. Once such skills are acquired and stored in LTM, automation to perform tasks follows.

2.2.3 Cognitive Loads Explained

Cognitive load theory proposes that instruction should help the learner to take advantage of biologically secondary knowledge stored in the LTM. The information presented should also be designed in consideration of the limitations of the WM, and should avoid imposing unnecessary load on the working memory for learners, specifically novel learners. It should however attempt to increase the load, which is essential to learning.

Cognitive loads are basically categorized depending on their function (Clark, Nguyen & Sweller 2006; Kalyuga 2011; Paas, Renkl & Sweller 2003; Pass, van Gog & Sweller 2010; Sweller, van Merriënboer & Paas 1998; van Merriënboer & Sweller 2005). The ‘intrinsic cognitive load’ takes its name because it is imposed by the intrinsic nature of the information. This load is imposed when learner makes attempt to acquire basic information structure; it does not take into consideration the instructional procedures. The second category of load during the process of learning is imposed by the instructional design. The way instruction is

designed and resources are used to present information can impose unnecessary load during the process of learning. This load is extraneous in nature, so it is called 'extraneous cognitive load'. (Kalyuga 2011; Sweller, Ayres & Kalyuga 2011)

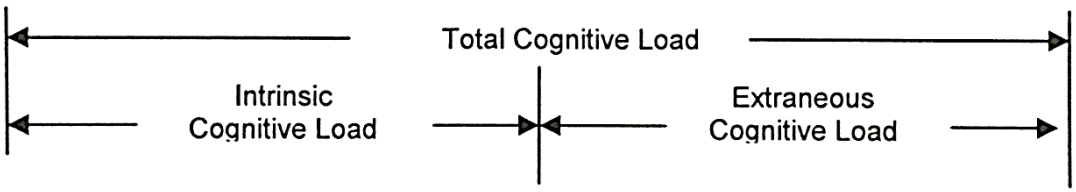


Figure 1: Intrinsic and extraneous cognitive loads (Chong 2005, p. 108)

The third category of load was added to CLT at a later stage (Sweller, van Merriënboer & Paas 1998). It was discovered that cognitive load was not always interfering with learning. For meaningful learning to occur, effortful cognitive processing should take place. The load that is essential to learning was given the name of germane cognitive load (Kalyuga 2011; Sweller, Ayres & Kalyuga 2011). The empirical research to find out effects of reduced cognitive loads on worked out examples brought forward the concept of germane load (Chandler & Sweller 1991; Kalyuga 2011).

2.2.4 The Effects

This section will briefly explain the cognitive load effects. **Goal-free effect**, the first effect tested, reduces the element interactivity and enables the learner in finding the solution to the problems without taking much cognitive load. Sweller (1988) used computational model and concluded that means-end strategy to solve problems imposed significantly more cognitive load as compared to goal-free approach. The conclusion that Goal-free approach is effective comes from various studies conducted over a period of more than ten years (Sweller, Ayres & Kalyuga 2011).

Worked-example effect is based on the fact that providing learners with worked examples helps build schemas and reduces the cognitive load while learners solve problems. The **problem completion effect** was discovered during the process of verifying worked-problem method as an effective instructional method. In problem completion, learners are exposed to semi worked problems, which they have to complete. This strategy is also proven to reduce the cognitive load during learning. The **split-attention effect** was a result of discovery when it was found that worked examples presented in certain formats proved to be ineffective.

Sweller, Ayres and Kalyuga (2011, p. 111) state that "split-attention occurs when learners are required to split their attention between at least two sources of information that have been separated either spatially or temporally." This specific strategy has been employed in the study and is further discussed in detail in chapter 3. When these two split-attention conditions are handled through auditory and visual medium, this is defined as **modality effect.** This form of instruction has also been employed in the current study. The specific effect was employed to provide readers with the visual images of the text read in order to process information without involving much mental effort. **Redundancy effect** is the careful combination of split-attention. If the students are provided with a written description of a self-explanatory text, this explanation is redundant and will occupy unnecessary space in working memory. Redundancy of information must be avoided so that learners can benefit most from required information.

It is essential to take into consideration the prior knowledge of the learner while designing the instruction. The information redundant for an expert learner may be essential for a novice learner. **Expertise reversal effect** is to design instruction to suit the level of expertise of the learner to avoid imposing extraneous cognitive load. **Isolated element effect** refers to learning essential elements alone that are required to build schemas to perform tasks of more element interactivity, which are also complex in nature. Related to the redundancy effect, reducing the redundant guidance for expert learners is named as **guidance fading effect.** The instructional design aimed at reducing the intrinsic and extraneous load by balancing the element interactivity is named **element interactivity effect**. All the effects are related to one another and mainly were formed as a result of extensive empirical research (Chong 2005; Cooper 1998; Schnotz & Kurschner 2007).

2.3 Theoretical Framework

2.3.1 Theories of Cognition

Attempts to define cognition are as old as the branch of cognitive psychology is (Carroll 1993; Galotti 2007; Mayer 2003). The attempt to find the origin of the studies of cognition will take us back to the time of Aristotle and Plato. Aristotle used the term "tabula rasa" to explain that human intellect is like a blank slate and that learning takes place through experiences we gain from environment around us (Murray 1988). Over a time period of ten decades, psychologists have conducted extensive research to understand how human brain presents and processes knowledge. The term cognition was first understood as a process of

association. As Mayer (2003 p. 47-48) explains Thorndike's associationist view "of learning as the strengthening and weakening of stimulus response associations and memory as the processing of linked nodes in a network". Another substantial development in refining the view of process of cognition was Gestalt view (Galotti 2008; Murray 1988; Mayer 2003) according to which cognition was seen as a series of cognitive processes. In other words, cognition occurs with a mental representation, an input, creates another representation, an output. The only problem with the Gestalt view was that the term cognitive processes and mental representation were too broad and researchers could not devise methods to observe and record such broad terms. This led to the Piaget's cognitive development theories. Piaget named the mental representations as schemas and proved that these schemas grow complex as the children age and acquire more knowledge (Galotti 2008; Long 2000; Slavin 2014).

2.3.1.1 Cognition and Language

Gontier (2009, p. 25-29) presents a very analytical view on the connection between language and cognition which concludes that human brain retrieves the factual knowledge about the physical world. Assumption is made that this factual knowledge is linguistically constructed. The example to explain this phenomenon can be given that the word 'tree' is the verbal expression of the mental representation. It can be concluded that the verbal expression and the mental image are connected by the word "tree". When we read a text or listen to a story, the brain constructs the mental images. Once the mental image is built, knowledge is constructed. This constructed knowledge is further expressed by using language. Thus, knowledge, process of knowledge, and the linguistic expression of it builds a tripartite that works and corresponds simultaneously. Clark (2003, p. 17-19) presents similar view but in a different perspective by stating that language may not play a significant role in building mental representations, but these representations are expressed using language regardless of which language is used.

Vygotsky has also claimed that language is essential to cognitive processes as analysed by John-Steiner and Mahn (2003, p. 132-137). According to them, Vygotsky claimed that "language is central to human mental development in a variety of ways". Vygotsky also claimed that symbols, maps, and drawings are also psychological tools that help to enhance mental functioning but language is essential, he adds, as it is also a cultural tool.

2.3.1.2 Cultural Context

Another view of cognitive development is Vygotsky's historical and cultural contexts of the children's intellectual development, and their interaction with the environment (Galotti 2008; Slavin 2013). Here, examining the term culture is needed. Pai, Adler and Shadiow (2006, p. 4) look at the term culture as "the knowledge, skills, behaviours, attitudes, and beliefs, as well as material artifacts, produced by human society and transmitted from one generation to another". They also emphasize on the importance of culture in learning as different teaching strategies and needs would arise in different cultures. This view is specifically important as the study is conducted in a setting where the first language of children is Arabic. The tradition of bed time story reading with the child or reading with children in general is at a very initial stage and is not a prominent feature of UAE culture as compared to other countries of English as a second language such as India (Dilworth 2014). Parents also tend to communicate with their children in Arabic rather than English. The rate at which cultural background of the students, who are part of the study, can help accelerate language acquisition is not very encouraging.

2.3.2 Biological Evolutionary Theories

Sweller, Ayres and Kalyuga (2011, p. 16-18) have viewed the human cognitive structure in a different context. They have made an attempt to find out the relationship between human cognitive architecture and biological evolutionary theories. They state that the genome size must be large as "organisms survive in complex, information-rich environments." The complexity of any natural environment is unlikely to be dealt with by a simple, small information store. On the contrary, "large and sophisticated store" will be required to "deal with the inevitable environmental variations it will face." The size or complexity of the genome cannot be measured, as agreed by the theory. They further explain that "… all genomes consist of, at a minimum, thousands, or in many organisms, billions of base pairs that can be considered units of information. (There is no consensus on what should be used as a measure of complexity but all measures yield very large numbers of units of information.)" They find a relation that if the genetic functioning of species and organisms rely on large information store; it is obvious that human cognition will rely on equivalent large information store as well. (Sweller, Ayres & Kalyuga 2011; van Merriënboer & Sweller 2005)

Building of this equivalent relationship is specifically interesting as knowledge is categorized into biologically primary knowledge and biologically secondary knowledge (Sweller, Ayres

& Kalyuga 2011). Considering the biological nature of knowledge, it is essential to find the obvious relationship between the cognitive structure and biological evolution. While analyzing the cognitive architecture and evolutionary biology, a clear link or pattern of similarity can be found between genome and long term memory. LTM plays the similar role as genome, i.e., storage of information. The information stored in LTM helps build schemas which enable a learner to perform complex tasks.

2.3.3 Theories of Development

Understanding how cognition works is very essential to the study conducted. As the study is based on cognitive load theory, the cognitive process plays an important role when it comes to learning information. Considering a detailed review of the four developmental stages of Piaget's theory may not be very significant, however, the second stage is of vital significance to the study and must be analysed. The study is conducted with the students of grade 2, 7 years of age. This age is named as 'preoperational stage' of development by Piaget. At this age, children's language and their ability to use language is accelerated. The vocabulary acquisition is rapid. The language learning process is complex at this age as children experiment with language and make efforts to clearly express themselves (Galotti 2008; Slavin 2014).

Piaget's stages of development were mainly criticized for two reasons: that children are more competent at each developmental stage than how Piaget has described, and that there is no boundary to the developmental stages; they overlap (Galotti 2008; Long 2000; Slavin 2014). The criticism has no negative limitation for the current study as the aim is not to define a certain age but to justify the choice. The main rationale of the study is that a specifically designed instruction can help students learn and perform better can also be linked to the non-Piagetian theories which demonstrated that the tasks designed to train the child can accelerate child' ability to perform at a specific age (Galotti 2008; Long 2000; Slavin 2014).

2.3.3.1 Zone of proximal development

The concept of zone of proximal development (ZPD) is also significant for the study. Vygotsky believed that children learn when they work within the zone of their proximal development (Galotti 2008; Long 2000; Orlich et al. 2013; Slavin 2014).

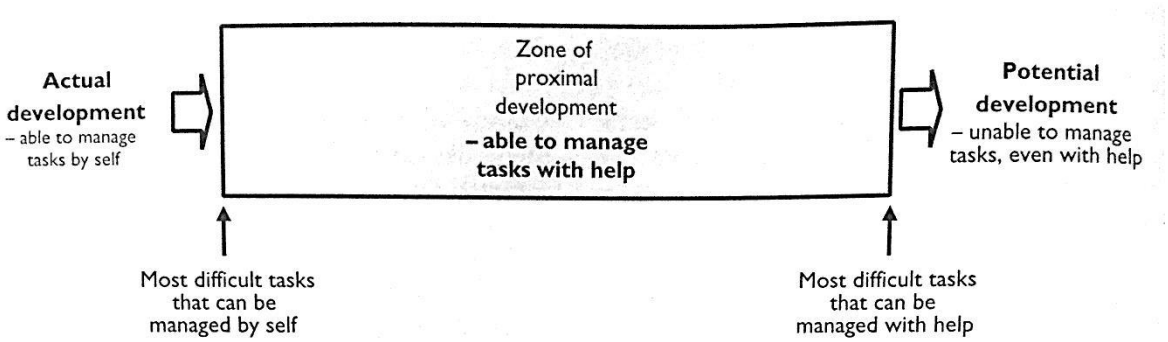


Figure 2: Zone of proximal development (Long 2000, p. 36)

When the instruction is designed appropriate to the ZPD, learning occurs rapidly (Orlich et al. 2013, p. 25), and if the right instructional strategies are used, learning can be maximized (Slavin 2014). Instruction should be designed in a way that will enable the learner to work within the proximal development zone. This will help construct schema, and the constructed schema will lead to automation in skills performance (Sweller 1994).

2.3.4 Theory of Schema

The development of CLT is very much related to the theory of schemas. CLT mainly brings forth cognitive load reduction to enable learner to construct schemas which help organize the information, while reducing the load on the working memory (Krischner 2002; Sweller, van Merriënboer & Paas 1998). In 1928, Piaget brought forward the schema theory. This theory proposed that children are born with the capacity and ability to interact with their surroundings. This thought gives the basis to the biologically primary knowledge. Piaget also states that to acquire new knowledge, we depend on existing schema and with the acquisition of new knowledge, construction of new schemas takes place.

Chi, Glaser and Rees (1982) define a schema as "a cognitive construct that permits us to classify multiple elements of information into a single element according to the manner in which the multiple elements are used." A lot of experiments have been conducted to find out how schemas are built and how do they function to process information. Sweller, Ayres and Kalyuga (2011, p. 22-24) describe a study conducted by Bartlett in 1932 to explain nature and function of schemas. The study was conducted on ten candidates to assess their ability to store and reproduce information. It was concluded that long-term memory has storage of schemas, countless in numbers. The way we process the information depends on the schemas stored in the memory. It can be concluded that schemas structure the information that allows us to perform complex tasks effortlessly.

2.3.4.1 Automation

Automation brings ease to effort, and absence of it makes it prone to error. Sweller (1994) discusses the dichotomous relationship between two possible ways to process information. He argues that the controlled and automatic processing of knowledge occurs under different circumstances. If the learner has already developed schema for letter recognition, to read a new text will be automatic, as the deliberation to make sense of letters and words is not needed. On the other hand, if the schema for reading and letters have not been developed, a deliberate input of effort is needed, and thus the reading the text will be a controlled effort. It takes time and practice to achieve automation. He concludes that expert learners have a large store of schemas that enables them to perform better as compared to novice learners.

Automation is acquired after practice which leads to task performance with least effort (Pass & Ayres 2014; Sweller, van Merriënboer & Paas 1998). Sweller (1994) concludes that schema and automation serve a joint purpose for the learner which is to reduce the load of working memory and ameliorate its capacity.

2.3.5 Development of Cognitive Load Theory

The cognitive load theory was developed in 1980s. The development of CLT gave a new dimension to the instructional design (Cooper 1998; Schnotz & Kurschner 2007; van Merriënboer & Sweller 2005). The capacity of working memory is limited to seven (plus or minus two) items, which seems limited but the main thinking and learning processes take place in working memory. CLT also complies with the same assumption of working memory. The empirical research on CLT proves that this principle mainly applies to the learning of the novice learners. Working memory does not have a limit when it comes to retrieving information from the long term memory (Pass et al. 2003; van Merriënboer & Sweller 2005). This can be further explained in relation to schemas. The long term memory stores cognitive information and schema are built. Expert learners do not depend on short memory to perform complex tasks, but on the schema built in the long memory. These schema help reduce load on the working memory. In contrast, for a novice learner, working memory can have limited capacity (van Merriënboer & Sweller 2005).

CLT consists of three loads as explained earlier. The two loads, intrinsic and extraneous are additive in nature (Chong 2005; Kalyuga 2011; Pass, van Gog & Sweller 2010; Sweller,

Ayres & Kalyuga 2011). The loads need to be in balance for effective learning to take place. The amount of loads depends on the element interactivity.

2.3.6 Element Interactivity and Cognitive Loads

It has been confirmed through research that extraneous load has completely to do with instruction. If the instruction is poorly designed, it will result in high extraneous load on the learner (Sweller, Ayres & Kalyuga 2011). The complexity of the information determines the extent of the cognitive load. Cognitive load can be decreased by breaking down complex tasks into more understandable and doable chunks of information. The manner in which instruction is designed determines how much of extraneous load will be imposed on the learner during the learning process. The complexity of the task is determined by the element interactivity (Chandler & Sweller 1991; Pass, van Gog & Sweller 2010; Sweller 1994; Sweller, Ayres & Kalyuga 2011). Sweller, Ayres and Kalyuga (2011, p. 58) define element interactivity as "elements that must be processed simultaneously in working memory because they are logically related. An element is anything that needs to be learned or processed, or has been learned or processed." In other words, elements by their characteristic are schemas. During the process of learning, sub-elements are incorporated into existing schemas. Thus the load of working memory is reduced by building many lower level schemas into lesser number of high level schemas. If the instruction is designed in a way that the element interactivity is balanced and is not unnecessary, it reduces the cognitive load.

The concept of element interactivity was brought forward by Maybery, Bain and Halford (1986) through conducting a research and providing evidence that element interactivity serves as a source of cognitive load. They made use of transitive inference problems to hypothesize that if the two premises of problems are integrated, the element interactivity will be at a highest point. Cognitive load theory outlines the three loads so that the instructional designers take into consideration the element interactivity to reduce the extraneous cognitive loads. Sweller (1994) explains that low element interactivity refers to tasks where elements of the task can be learnt in isolation. This can be explained through an example. If the learners are assigned a task of finding meanings of the words, the element interactivity is low as the only task is of finding the meanings by using dictionaries. If the same vocabulary words are asked to be used in a meaningful paragraph, the element interactivity is high as the knowledge of good paragraph writing, sentence rules, and syntax need to be known to perform this task and all these elements must interact simultaneously so that the learner can

perform the task. Similarly, to perform an algebraic calculation, the learner must be familiar with simple calculation rules first and in order to calculate complex algebraic expressions, all the elements should be engaged at the same time (Clark, Nguyen & Sweller 2006; Sweller 1994). Research also concludes that constitution of element interactivity also varies from one individual learner to another. It is essential then, to determine the current knowledge level of the learner to estimate the element interactivity.

Once extraneous load is reduced, it frees the working memory to handle the intrinsic load, thus increasing germane load. Being additive in nature, higher intrinsic load should be balanced by reduction of extraneous load. If not taken care of, the total load may exceed cognitive capacity and prevent germane load, hindering the occurrence of effective processing of information (Clark, Nguyen & Sweller 2006; Sweller 1994).

Sweller (1994) confirms that element interactivity will differ for a novice and expert learner. He explains that a novice learner will attempt to solve a more complex task of solving an algebraic word problem. The basic algebraic expressions to solve the algebraic word problem will be the elements of algebraic word problem. Thus he proves the notion that similar numerous lower level schemas develop into fewer but high order schemas (Clark, Nguyen & Sweller 2006).

2.3.6.1 Rote learning and learning with understanding

The next advancement made in cognitive load theory is to explain the cognitive load for rote learning and learning with understanding. Clark, Nguyen and Sweller (2006, p. 62-64) stipulate that rote learning and learning with understanding differ quantitatively and not qualitatively. It is essential to understand the difference between the two types of learning and the element interactivity for both. If the task of learning a times table needs to be accomplished, it can be achieved either through memorizing the expression of 2 x 4=8 or through reasoning that 8 is the result of multiplication because 2 is added up 4 times. Qualitatively, the result of both types of learning will be the same; the learner will eventually know that 2 x 4=8. However, the element interactivity in both ways of learning, which is the quantitative aspect, will be different.

In case of rote learning, the elements interacting for times table will not exceed five, including the numbers and the symbols involved in the expression 2 x 4 =8. In case of learning with understanding however the element interactivity will be higher. This is so because learner has to make an effort to reason why the answer is 8 and not any other

number. The learner also needs to take into consideration other possibilities such as 2 + 2 + 2 + 2 = 8. The learner makes an attempt to understand that two different mathematical functions, multiplication and addition, give the same answers which does not happen by coincidence. Now all these elements added result in increased element interactivity. This interactivity will be even higher if the learner will make an attempt to understand that 2 × 4 = 2 + 2 + 2 + 2 = 4 + 4 = 4 × 2 = 8. The attempt to understand the relationship between addition, multiplication, and division will further result in increased element interactivity thus increasing load on working memory. This high level of element interactivity is reduced during mere memorization but it will not help build the schemas which will be required to perform complex tasks. When a learner will understand the logical reasoning of the expression 2 x 4 = 4 x 2, he will also be able to apply it to a different expression such as a x b = b x a. This type of automated learning is not possible to occur through rote learning. It is also opined that rote learning, especially at lower age levels may be essential to build schemas but must be accompanied by logical reasoning and understanding for a complex learning ability (Clark, Nguyen & Sweller 2006; Sweller 1994; Sweller, van Merriënboer & Pass 1998).

2.3.6.2 Measuring Element Interactivity

Sweller (1994) and Sweller and Chandler (1994) conclude as a result of their research that the following aspects should be considered while measuring the element interactivity of a task.

a. Existing knowledge of the learner
b. Numbers of elements simultaneously required to perform the task

Existing knowledge of the learner is important to consider as the element interactivity of a task may be low for a learner who has developed schemas and may be more for a learner who has yet not acquired essential schemas needed to perform the task. Once the knowledge level of the learner is determined, estimation of interacting elements of a task is possible. Sweller (1994, p. 306,307) and Sweller and Chandler (1994, p. 190,191) gave two examples to measure the elements interactivity for tasks and agreed on the conclusion that the elements required to be performed are of little significance if performed in isolation. While calculating the element interactivity, it is also assumed that learner is at a certain level of expertise.

2.4 Related Studies

A review of the studies conducted on cognitive load theory and its implications for instructional design suggest that instruction must be designed to match the learner's expertise. The sole purpose of cognitive load theory, that over rides any other goal, is to discover methods to design innovative and novel instructional strategies aimed at enhancing the learning efficiency (Chong 2005; Schnotz & Kurschner 2007; Sweller, Ayres & Kalyuga 2011).

2.4.1 The Effects of Cognitive Load Theory

Over thirty years of CLT research has brought forward many effective instructional procedures. Sweller, Ayres and Kalyuga (2011, p. 87) state that each of these instructional procedures "flows from a cognitive load effect where an effect is an experimental demonstration that an instructional procedure based on cognitive load theory principles facilitates learning or problem solving compared to a more traditional procedure." The figure below demonstrates these effects. The principles of the three effects used in the study are highlighted in purple (figure 3).

Figure 3: Effects of cognitive load theory

The effects are a result of extensive research conducted on control and experiment groups with randomly assigned participants. The experiments conducted on these groups consisted of two phases. The first phase was the instructional phase and the second phase was the test phase.

During the instructional phase, the groups were taught either through traditional instructional method or by the new methods proposed by cognitive load theory. In the second phase, the groups took tests to measure learning outcome differences. For any cognitive load effect to be considered as a superior instructional method, the statistical data resulting from experiment must demonstrate learning outcome gains made by the learner. The ten effects in the diagram when tested in a number of experiments, have proved to be effective instructional designs based on the instructional outcome gains made by the groups (Schnotz & Kurschner 2007; Sweller, Ayres & Kalyuga 2011).

Similar test approach has been adopted in the current study where the control and experiment groups are exposed to two phases; the phase of instruction and phase of test. The experiment group receives cognitively modified instruction whereas control group goes through typical instruction as outlined by the adopted school curriculum. At the end of the instructional phase, both groups take the test to measure the learning gains made.

2.4.2 Measuring Cognitive Load

Measuring cognitive load is essential to cognitive load theory and research related to that (Ayres & Pass 2012). A lot of experiments have been conducted to test the cognitive load theory and its effectiveness. In order to do so, it was essential to measure the cognitive loads. The initial research conducted by Sweller (1994) and his colleagues hypothesized that higher level of research on problem solving will result in high load on working memory as compared to low problem solving research. Sweller (1988) debated that schema construction was obstructed as the cognitive load imposed by the first condition was high. He confirmed the hypothesis as a result of computational model used in the research. It was the first attempt to find out that cognitive load is an essential factor in the instructional design. Other measures to anticipate cognitive load were taken into consideration by observing the performance during the learning phase, concluding that if the cognitive load will be high, it will affect the future performance as well. Error rates in early researches conducted were also analysed to interpret the cognitive load imposed on the learner. (Ayres & Pass 2012; Sweller, Ayres & Kalyuga 2011).

As the CLT further developed in 1990s, it was recognized that more direct methods to measure the cognitive load were absent, and there was a need to have such measures in place. Pass (1992, p. 429) argued that introspection by the learner of the amount of effort invested towards the completion of a task can help gauge the cognitive load learner has gone through. He used a 1-9 point Likert scale, ranging from very, very low mental effort (1) to very, very high mental effort (9) and asked learners to rate their mental effort. The scale was slightly altered later on from mental effort to how easy or difficult the task was rather than the mental effort.

Pass et al. (2003) opine that cognitive load can be measured by measuring mental efforts, mental load, and performance. He explains that mental effort refers to the cognitive capacity that accommodates the cognitive demand imposed by the task. It is measured while the learners are performing the task. Efforts to accurately measure cognitive load brought in conception the measurement of efficiency. Pass and van Merriënboer (1993) further built on Pass' (1992) findings while measuring the instructional condition efficiency, and concluded that it was essential to measure the cognitive cost of learning. The concept of mental efficiency that they brought together combined the mental effort and performance.

To find the efficiency, Z scores of mental effort and performance should be subtracted. More mental effort and less performance will indicate low efficiency which means cognitive load taken was more. Lower mental effort and high performance will indicate better efficiency which means less cognitive load was taken during learning.

The formula for efficiency is $\mathbf{E = Z_{Ptest} - Z_{Etest} / \sqrt{2}.}$

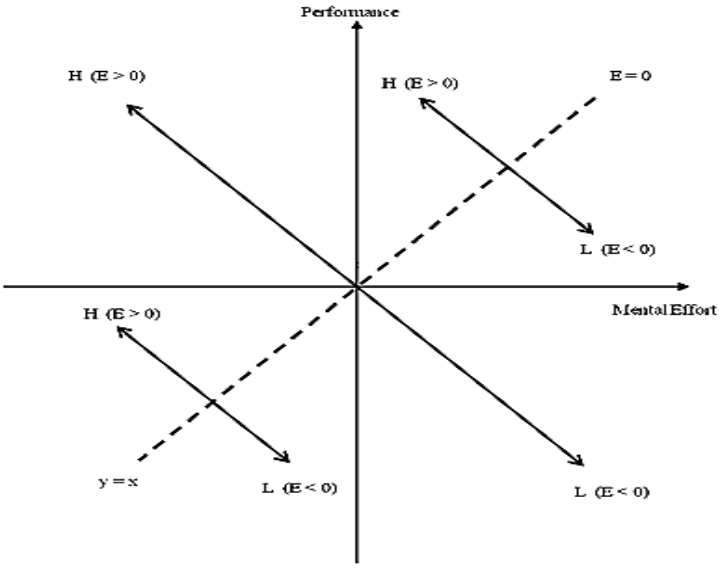


Figure 4: Graphical representation of efficiency (Sweller, Ayres & Kalyuga 2011, p. 76)

Z_{Ptest} is the standardized performance Z score and Z_{Etest} is the standardized mental effort Z score.

Although the methods devised have helped great deal in measuring the cognitive load, Hoffman and Schraw (2010, p. 2) claimed that "there is no consensus in educational and psychological research as to the measuring of efficiency, how efficiency should be measured, or how to model factors that affect rate or amount of learning due to a treatment intervention." They named the method of calculating efficiency as "deviation model". They argued that that the two variables that are subtracted through deviation model are of different conceptual nature, however, depending on the nature of the research, the method applied can yield the results aimed for.

2.5 Research Related Studies

The concept of cognitive load theory is not ancient, and is a major theme of recently conducted studies. The current study is also inspired by the cognitive load theory. As mentioned earlier, the study aims at finding the impact of instruction that is designed to reduce the cognitive load by employing some of the cognitive load effects in instruction designed for the students of English as second language. Most research carried out so far, had been focused on reducing the cognitive load studies of Mathematics. One possible reason could be the perception that mathematical problem solving involves high element interactivity, and it will be more helpful in examining the cognitive load amount and its reduction. The current study however addresses the similar issues in second language acquisition. The principle of element interactivity is also very much applicable to other subjects. In language, while learning to construct sentences and then small paragraphs does involve high element interactivity. There has not been much experimented with regard to cognitive load theory in the second language acquisition however, to make any further conclusions based on previous research (Moussa 2008).

Sweller and Chandler (1994) conducted experiments to test the hypothesis that instruction designed to reduce the element interactivity will result in improved performance of the learners. They conducted the first experiment to analyse the impact of split-attention effect on the performance of learners. The experiment group was presented with information that facilitated their learning through images and explanations unlike the control group who were given the conventional instruction. Both groups took test at the end of the instruction. On the first part of the test where element interactivity was less, both groups showed similar performance. However, on the questions which involved high element interactivity, the

students who were given modified instruction performed better than the other group. This study was replicated with an additional group in the second experiment, a third group. The third group was given more resources to manipulate with in order to make sense of the information. The results analysed through ANOVA confirmed that instruction modified to reduce cognitive load enabled the students to outperform the other two groups for whom the cognitive load was not reduced. Kalyuga (2007, p. 515) in his review of studies conducted on expertise reversal effect confirms that the longitudinal studies conducted were supportive of the expertise reversal model where the cognitive load was reduced and students' performance was improved.

The current study is similar to one conducted by Balyney, Kalyuga and Sweller (2015) where they examined the effect of instruction tailored by the principles laid out by cognitive load theory on students' performance. They employed expertise reversal effect and isolated interacting element effect to design the instruction. Based on the post-test performance of the students in multimedia learning, they concluded that instruction, which was adaptive and took learner's expertise into consideration, helped them perform better than the group who did not receive a specially tailored instruction. The current research also employed modality effect considering the need of the subject and age of the participants. For the calculation of the efficiency and drawing calculations, the "approach to combine mental effort and performance" is suggested by Pass and van Merriënboer (1993, p. 739-742). Additional method of lesson observation was also part of research as the age group was too young to assess the mental effort on the scale. Lesson observations were conducted to record student responses and effectiveness of the instructional design.

2.6 Summary

The chapter details the concepts which are essential for a sound understanding of the research perspective. Certain concepts such as human cognitive architecture and the loads are specifically related to the main concept of the study. The comprehensive study of the human cognitive architecture enabled the researcher to have an in depth analysis of specific effects that could be employed to reduce the cognitive load during the process of language learning. A very essential theory pertaining to the research is the schema theory. The concept that built schemas process information, and enable the learner to perform complex tasks also helped the researcher in instructional planning through a careful choice of learning materials and activities.

Cognitive load theory is the main spine of the research. Cognitive load theory has brought forward the concept that learner goes through different loads while learning and managing these loads is essential for effective learning to take place. A lot of studies have been conducted that have concluded that reduced cognitive load leads to better learning and skills performance. The current study also examines the similar principle of the cognitive load theory. The study employed three effects, which are explained in the chapter 3 in detail, to modify the instruction so that the element interactivity was balanced to reduce the cognitive loads.

Chapter 3 Research Design

3.1 Introduction

This section of the research provides details about the research design. The main objective of the research is to find out if the instructional methods adopted to reduce cognitive load will result in improved impact on vocabulary acquisition of the students. CLT has presented ten possible instructional methods which, if adopted, can help reduce the cognitive load of the learner (Sweller, Ayres & Kalyuga 2011). The research also aims at concluding, through the observation, that if the modified instruction will enable students acquire skills to perform complex tasks such as acquiring vocabulary. The study employs the cognitive load effects (the instructional methods defined by CLT) in instruction to reduce element interactivity while students learn isolated tasks. These tasks help them build schemas which are essential to perform complex tasks (Sweller 1988; Schnotz & Kurschner 2007; van Merriënboer & Sweller 2005).

3.2 Research Design and Methodology

The research is experimental in design. In an experimental research, at least one hypothesis is made stating an expected causal relationship between two variables (Gay, Mills & Airasian 2012). The group that receives a different treatment in an experimental research is called the 'experiment group' and the group that acts as a controlled variable, is called the 'control group.'

The study employs three cognitive effects to modify instruction. A study conducted by Musavi, Low and Sweller (1995) examined the effect of split-attention and modality effect on the learners of second language. They proposed that the cognitive effects resulted in reduced cognitive load. The experiment group received instruction that was modified as per the three effects (discussed in chapter 3) whereas the control group was exposed to regular instruction. Similar research approach was found in the study conducted by Gillmor, Poggio, and Embreston (2015). Both groups took a pre-test to determine the current performance and mental effort of the students. After an instructional time period of four weeks, 6 lessons of 50 minutes per week, students took a post-test to determine the difference in performance as a result of modified instruction. Both qualitative and quantitative methods of data collection were employed.

3.3 The Setting and Sample of the Research

It was difficult to get consent of a school for a study conducted over a time period of 4 weeks, especially when modifying instructional design was part of the research. The research was conducted in an American curriculum school of Dubai, UAE where the researcher was employed as a high school English teacher and coordinator for middle and high school English. The school was selected for the study because of its proximity for the researcher. Grade 2 was chosen as sample for various reasons (discussed in chapter 1 and section 3.7).

Total school population (at the time of study) was 1200 students with classes offered from KG to grade 12. Total students of grade 2 were 100, enrolled in four sections i.e. A, B,C, and D. 52 out of 106 students (52 %) of grade 2 were the research participants. In the elementary section, class teachers are deployed to teach English, Maths, and Science to their allotted sections. 92% of the school population involved in the study is second language users of English. The first language of these students is Arabic. The existing class with all students was selected. The participants of the control and experiment group were not assigned randomly. The choice of the grades section as experiment and control however was random. Grade 2A was the experiment group and grade 2B was the control group.

Group	Experiment	Control
Number of students in class	28	24
Number of boys	17	13
Number of girls	11	11
Number of first language users	0	0
Arabic as first language	24	24
Average age in years	7	7

Table 1: The study sample

All the students involved in the study were second language English speakers with Arabic as their first language. The only exception was 4 students in the experiment group who did not have Arabic as first language. The school principal was approached for the permission to

conduct the study in the school premises. The sections the permission was granted for were grades 2A and 2B. The teachers of two sections agreed to be a part of the study.

3.4 Instruments of the Research

Pre-test (appendix D) and post-test (appendix E) were taken to collect data in order to compare the performance of the control and experiment groups before and after the treatment. In an experimental research design, pre-test is taken to sensitize the participants to the treatment (Gay, Mills & Airasian 2012, p. 258) and thus helps to measure the effect of the treatment (cognitively modified instruction). Pass and van Marrienboer (1993, p. 738) define performance as "the effectiveness in accomplishing a particular task" and state that it can be measured by test scores.

To measure the mental load, a 7 point Likert scale (appendix F) was used. Pass and van Merriënboer (1993, p. 738) define mental effort (ME) as "the total amount of controlled cognitive processing in which a subject is engaged", and state that it is often measured by using a rating scale. Pass (1992, p. 429) argued that a learner can provide an introspective view of the mental effort exerted on a task. Pass et al. (2003) propose that mental effort should be "measured while participants are working on the task." The students were asked to complete the 7 point Likert scale right after they completed the pre and post-tests. NASA TLX (Task Load Index) was used as a reference (Hart & Staveland 1988) to develop the scale to measure the mental load. The NASA TLX is a multidimensional tool assessing various variables, the 7 or 9 point Likert scale however in unidimensional, assessing only one aspect. The scale is either a 9 or 7 point Likert scale. In the study, the scale was of 7 points considering the age group of the participants. This was modeled after Paas and van Merriënboer's (1994) rating scale where students were asked to indicate how difficult or easy the task was for them. Van Gog and Pass (2008) state that it is preferable to ask participants to rate task difficulty rather than mental effort on the scale, as they may perceive the mental effort differently. They also suggest that the 'unidimensional' scale can be used multiple times; after the test, or after every single task completed for "a fine grained analysis." The ratings selected/indicated by the participants were subjective. Schnotz and Kurschner (2007, p. 499) state that subjective data can be questionable; however they are a form of data which can bring forth valuable results if used carefully. The main issue with the subjective data for mental effort was individuals' perception of the terms. To make it more understandable for

the students, a visual image was added to the description (appendix F) so that they could represent a real reflection of the mental effort exerted during the task.

Non-participant lesson observations (appendix H) were used to as a qualitative measure of the research data collection. The main objective of the lesson observation was to develop a sound understanding of the natural learning environment as experienced by the learners without any manipulation (Gay Mills & Airasian 2012 p. 381). Kawulich (2005) states that observation helps the observer to use five senses to observe and record data. For the study, 'selective observation' was chosen (Kawulich 2005), as the main focus of the observation was to collect first-hand information of different type of activities. These activities were designed based on the cognitive effects that were employed to reduce the cognitive load of the learning.

3.5 Instructional Modification

A very significant aspect of the research is the instructional modifications that were made to reduce the cognitive load of the learners. The research has employed three cognitive effects. The split-attention effect results in splitting student attention through two sources of information which are spatially or temporally separated. Sweller, Ayres, and Kalyuga (2011, p. 111) point out that "from a cognitive load theoretical perspective, each source of information must be essential to an understanding of the overall content to be learned and must be unintelligible in isolation." Research has indicated that use of multimedia resources in instruction is a good strategy to reduce cognitive load (Sweller 1999). In planning the instruction, multimedia resources were used to facilitate learner in reducing the extraneous load. The resources used were flip charts, pictures, videos, and audios. As proposed by Sweller (1999, p. 98), cognitive load theory does not distinguish between resources used in isolation. The audio-visual resources were combined and pictures had short description that were used to aid learning. The texts used also had a pictorial representation for better understanding.

The modality effect is closely related to split attention effect. It can only be obtained when "two sources of information are unintelligible in isolation" (Sweller, Ayres, & Kalyuga 2011, p. 129). By providing audio of textual information, modality effect cannot be generated as both mediums contain the same information in a different mode. If the two sources are used, they must be presented in a way that the reader refers to the other source in order to comprehend the first. Studies conducted confirm positive impact of instruction on students'

performance which employed modality effect (Kadir, Gulkan & Jennifer 2015; Mousavi, Low & Sweller 1995). Employing modality effect in instruction makes the classroom environment interactive. The modality effect is a refined form of split-attention effect and its use ensures that split-attention effect is appropriately employed to design instruction.

The redundancy effect in its explanatory approach is opposite to the split-attention and modality effect. Unlike the other two effects, redundancy effect implies that multiple sources of information can be understood without mental integration (Sweller, Ayres & Kalyuga 2011). This can add to the extraneous load a learner will take during task completion. If a learner is presented with a self-explanatory graph and a written explanation of the same graph is provided, the written information becomes redundant and unlikely to benefit the learner, as it is not required by the learner to depend on the test to understand the graph (Cooper 1998). The redundant information should be eliminated to reduce the extraneous load that can be imposed otherwise. Chandler and Sweller (1991) conducted various experiments, where similar information was presented in various modes without requiring mental integration of the resources. They recommend avoiding redundancy effect to take the extraneous load off the learner's mind.

The three effects selected for the study were not a random selection but were selected after a careful examination of empirical evidences of these effects and their implications for learning. The split-attention and modality effect are very essential part of the instruction. Students at a young age learn more effectively when multimedia resources are employed to the learning environment. To the students of a second language, a lot of exposure to the audio and text versions of the language occurs on daily basis. Sweller, Ayres and Kalyuga (2011, p. 146) point out that redundancy effect has been used in Maths, Science, and Engineering. They propose that an important domain of study to explore the impact redundancy effect on learning is foreign or second language acquisition. These effects were selected because the guiding principles for the three effects have been reported by pervious research to have reduced cognitive load for the learners of second language.

3.6 Role of Researcher

The researcher was a high school teacher and supervisor of English department of middle and high school. The request of conducting a research in school was welcomed by the school principal. The researcher had no responsibility in any area of elementary. There was no direct

connection of the researcher with elementary teachers, instruction or any other processes as these areas were taken care of by the elementary team leaders and head of elementary school.

Being of an experimental design, the quantitative data collection was carried out through experiment and control groups and was purely participant oriented. During the qualitative data collection, which was lesson observation, the researcher had an attic role. The researcher was just an instrument of data collection. The researcher was also responsible for designing the instruction as per the cognitive effects employed. The designed instruction was shared with the teacher. Since the researcher was not the instructor, the lesson observations were conducted by the researcher to ensure that the instruction was delivered the way it was planned considering the principles of cognitive load effects.

3.7 Ethical Considerations

Prior permission was obtained from the school administration to conduct the research on the school premises. The agreement of both the teachers of grade 2 was obtained. The teachers were explained the purpose and design of the study, however, the hypothesis was not shared with them. The teacher of control group only participated to help collect data. The teacher of experiment group was made aware of extensive class observation and was assured that it was a procedure to collect data and that it bore no judgment of the teacher's ability to teach or any other evaluation. The identities of the teachers and students were kept confidential. The findings resulting from the observation of experiment group were not shared with any member of the school. The scores of the students in pre and post-test were not used for any purpose other than research analysis (Gay, Mills & Airasian 2002; Kawulich 2005).

3.8 Data Collection

A mix method approach was used for data collection so that the synergy and strength of both qualitative and qualitative methods could be used to understand the phenomena under study comprehensively than relying on single method alone (Gay, Mills & Airasian 2012). The pre-tests and post-tests serve as a quantitative tool to measure the student performance. The pre and post-test were similar in style of questioning. Sweller and Chandler (1994) used a similar questioning style approach to test students' performance on pre and post-tests. The vocabulary words (appendix G) used for both tests were same in number. The comprehension text used on the pre-test was of 430 lexile range and those of post-test were of 450 lexile range. It is expected that an approximate level of 30 lexile should naturally increase after an instructional time period of four weeks, 6 lessons of 50 minutes per week.

Mental effort scores were collected using the 7 point Likert scale. The mental effort is reflective of the cognitive load the learner has taken during the task performed (Sweller & Chandler 1994). The lesson observations were used as a qualitative tool to evaluate lesson effectiveness. Observations were conducted to evaluate student response, interest, and motivation during lessons. Mental effort scores were collected to measure the amount of cognitive load introspectively indicated by the learner. The tables 6a, 6b, 7a, and 7b show raw score of pre and post-tests of the students.

3.9 Data Analysis

3.9.1 Quantitative Data

The quantitative data was analysed by using deviation model (Hoffman & Schraw 2010). As per the deviation model, efficiency metric was calculated, which is mathematically expressed as E = P – MF. To understand the deviation model, it is essential to explain the following terms.

Z score

Z score converts the metrics to a standardized scale. "Z score converts the average of a set of numbers to 0 and the standard deviation to 1. Thus, any individual Z score is expressed in terms of its distance in standard deviation from the average" (Clark, Nguyen & Sweller 2006; Pass & van Merriënboer 1993).

$$\text{Formula for Z score} = \frac{\text{raw score} - \text{average of all scores}}{\text{Standard deviation of all scores}} \quad \text{or} \quad Z = \frac{\overline{X} - X}{S}$$

Efficiency metric

Efficiency metric (explained above) denotes that if the performance is lower than mental effort, efficiency is low. Similarly, if the performance is more that the mental effort, efficiency is high. Statistical Package for Social Sciences (SPSS) version 22 was used to calculate Z scores.

$$\text{Equation for Efficiency} = \frac{\text{Average performance in Z scores - Average performance in Z scores}}{\sqrt{2}}$$

To view the results from a different perspective, paired *t* test was also conducted. This method of analysis has been used by Sweller and van Chandler (1994) while reporting effect of reducing cognitive load by designing instruction based on worked example effect.

3.9.2 Qualitative Data: Lesson observation

Lesson observation findings and descriptions were qualitatively used to analyse how much were the students responsive during the lessons. It was also used to validate the delivery of the instruction as per the cognitive methods employed in the research. A simple lesson observation format (appendix H) with descriptive and evaluative notes was prepared taking into consideration the parameters presented by Gay, Mills, and Airasian (2012, p. 382-386). The lesson plan recoded number of the observation conducted, date and time of observations and duration of the observation. The descriptive notes were taken by the researcher and evaluations were made to see if the instruction delivered was reflective of the cognitive effects used. Students' engagement in lesson was observed along with their response to the given task (appendix P).

3.10 Limitations and Delimitations of Research

It has been discussed in chapter 2 that for a reduced cognitive load, the element inactivity of a task should be less. Element interactivity is the number of skills required at an instance to perform a task. To reduce element interactivity, the cognitive load effects (instructional methods) have been suggested. As mentioned in chapter 2, the empirical research has proved that the cognitive effects reduce the cognitive load and increase the performance of the students. The cognitive loads are measured through a mental effort score, as described in the section above. The limitation of the mental effort is, which indicates the cognitive load taken, that it does not distinguish between the three cognitive loads (Schnotz & Kurschner (2007, p. 500). Schnotz and Kurschner (2007) state that for the empirical research to examine the impact of cognitive effects on instruction, introspection of mental effort is sufficient. They predict that this limitation of cognitive load theory is not possible to be addressed in near future.

Another issue faced is determination of the prior knowledge of the students. As it is discussed in chapter 2 that to reduce the cognitive load, it is very important that the prior knowledge of the student or the current level of expertise is taken into consideration so that the learning is within the zone of proximal development of the learner (Schnotz & Kurschner 2007, p. 504). Redundancy effect also follows the same principle. If the learner is presented with information that he knows already, presenting the same knowledge will be redundant and can impose cognitive load on the learner. It can be challenging to determine the level of expertise of each individual student to avoid redundancies, but it is achievable. A careful planning that

meticulously analyses factors such as student's performance on an external benchmark test, teacher's evaluation of the student's performance, diagnostic tests, and student's progress over time as indicated by various types of assessments taken, can help determine the prior knowledge of the learners.

A review of literature, as presented in chapter 2, indicates that a lot of empirical studies have been conducted on cognitive load theory. These cover measuring the effect of learner-tailored instruction on student performance in Maths, Science and media learning (Kalyuga 2007; Sweller & Chandler 1994), to finding the effect of reduced the cognitive load on students' performance on test items (Gillmor, Poggio & Embreston 2015). Not much has been done in the field of second language acquisition. Exploring the impact of cognitively modified instruction on vocabulary acquisition is interesting for this reason.

The study results will be specifically applicable to the setting of the study. Teachers of early elementary sections that teach English as a second language can benefit from the results to reduce the cognitive load of the learner for better skills acquisition. The participants of the study were pre-tested to determine the current level of performance. After an instructional time period of four weeks, the groups were post-tested to see the improvement in performance level. The treatment was given to the experiment group only. The results indicated that the experiment group has shown overall improvement in their performance after receiving the modified instruction.

Chapter 4 Findings and Discussion

4.1 Introduction

This section will provide a detailed discussion of the research findings and data analysis. Various findings obtained through the instruments explained in chapter 3 will be presented through tables and graphs. The findings will be discussed in relation to the research questions. The pre and post-test scores of performance are analysed by obtaining Z score. In the table (table 7) 0.4 Z score of a student will indicate that the score is 4 tenth above the standard deviation (Clark, Nguyen & Sweller 2006). Efficiency graphs are used to represent the efficiency of students' performance. On the efficiency graph, the horizontal axis represents the mental effort scores and the vertical axis represents the test performance. The intersection of two axes represents the average of all ratings which equals to 0. If the performance is low, and mental effort is more, the efficiency will be in negative. If the performance is more than the mental effort, the efficiency will be positive (Clark, Nguyen & Sweller 2006; Pass & van Merriënboer 1993). The lesson observations are qualitatively analysed to describe the effectiveness of the lesson and student response during lessons.

4.2 Quantitative Data Findings

The raw scores of the performance and mental effort tests (tables 6a ,6b ,7a,7b) were used to calculate the mean and standard deviations. Both variables are essential for calculating the Z scores. The students of experiment and control group were tested at the beginning of the study to determine the level of the performance before the treatment for the experiment group stated. After an instructional time period of four weeks, post-test was taken.

Control Group

		Mean	N	Std. Deviation	Std. Error Mean
Performance	Pre Test	43.9000	24	19.34038	3.94784
	Post Test	37.3875	24	16.54328	3.37688

Table 2: Mean and standard deviation of performance test of the control group

Experiment Group

		Mean	N	Std. Deviation	Std. Error Mean
Performance	Pre Test	53.2646	28	20.27102	3.83086
	Post Test	61.3964	28	22.18242	4.19208

Table 3: Mean and standard deviation of performance test of the experiment group

From tables 2 and 3 it is evident that experimental group performed significantly better than the control group. The experimental group performed better than the control group in the pre-test. The performance gap however was even larger in the post test.

Control Group

		Mean	N	Std. Deviation	Std. Error Mean
Mental effort	Pre Test	4.1	24	2.0	0.42
	Post Test	4.2	24	1.8	0.38

Table 4: Control group mean and standard deviation of mental effort score

Experiment Group

		Mean	N	Std. Deviation	Std. Error Mean
Mental effort	Pre Test	4.6	28	1.6	0.31
	Post Test	4.3	28	1.8	0.35

Table 5: Experiment group mean and standard deviation of mental effort score

Z scores were calculated (tables 4 and 5) for the individual raw score (formula can be viewed in chapter 3). The Z scores for metal effort were also calculated and efficiency scores for both pre and post-tests were obtained for both groups. The post-test of experiment group shows a drop in mental effort score. The mean of the performance score increased. The relationship between performance and mental effort indicated that students' performance was efficient as compared to the performance in the pre-test.

Control Group

		P	ME	Efficiency
Z score	Pre Test	0.021	0.05	-0.021
	Post Test	-0.21	0.02	-0.166

Table 8: Z score and Efficiency of the control group

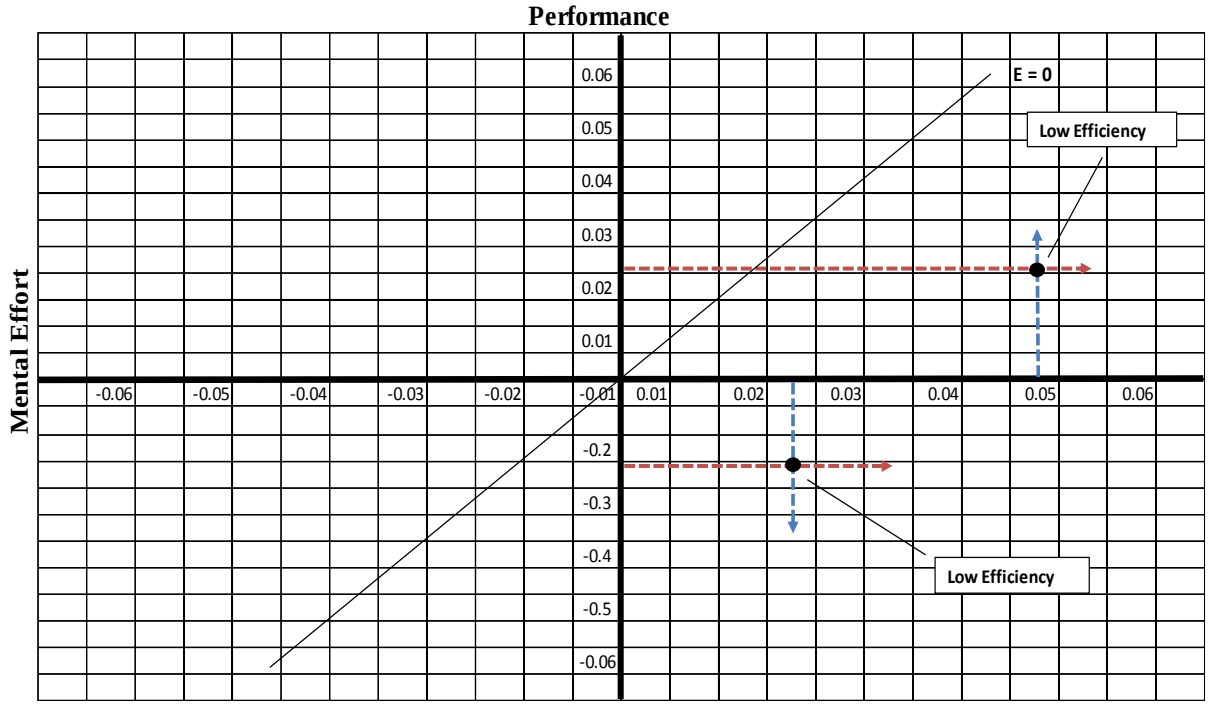
As mentioned earlier, the Z score converts the averages to get a standard score equal to 0. The efficiency of the control group is in negative in both the tests. The data reflects that the efficiency of the control group is negative in pre and post-tests. Accordingly to Clark, Nguyen, and Sweller (2006), if the efficiency is in negative, the performance of the students is less than the mental effort exerted. In control group, the instruction was not consciously modified to reduce the element interactivity. There is no evidence that the instruction suited the level of the students. The only evidence that has been collected through performance and mental effort reflects that the performance is less than the mental effort exerted in both tests.

Experiment Group

		P	ME	Efficiency
Z score	Pre Test	0.043	0.129	-0.08
	Post Test	0	-0	0.01

Table 9: Z score and Efficiency of post-test of experiment group

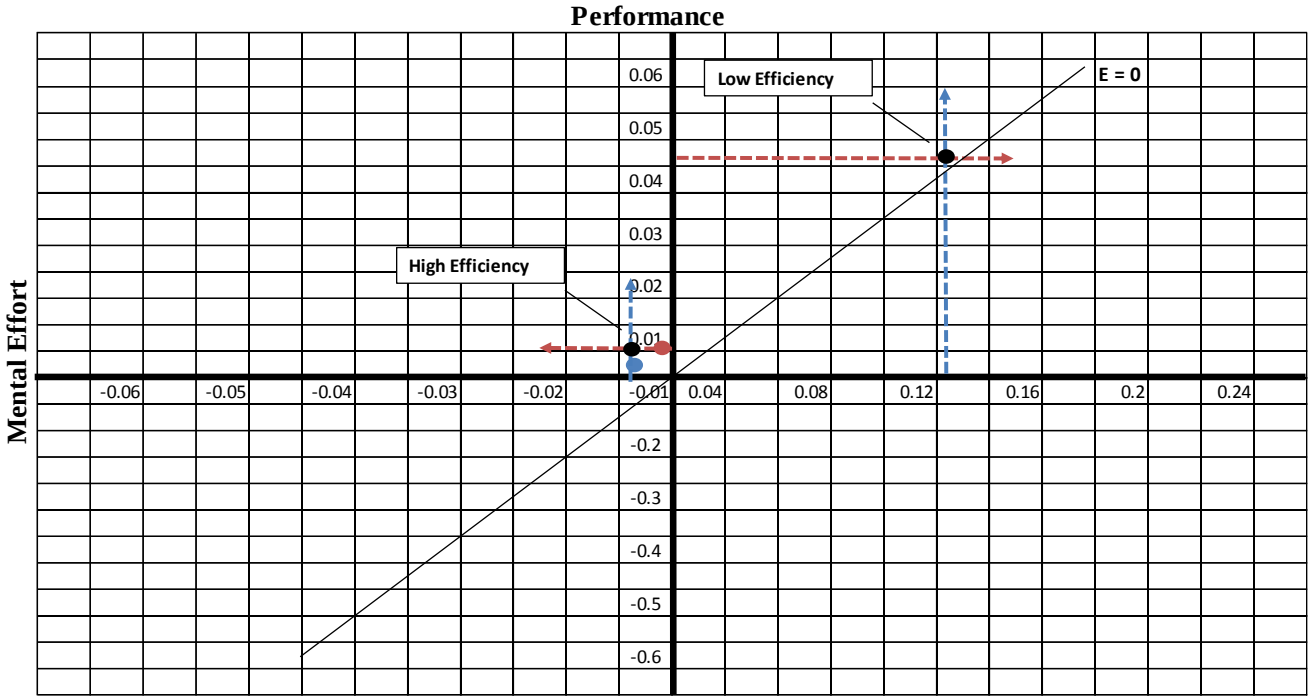
Comparing the values presented in table 8 and 9, it can be concluded that the control group participants have exerted more mental effort in pre-test and pot-tests. The overall efficiency score is negative. Mental effort however was reduced in the post-test but performance also decreased. In comparison, the experiment group had more mental effort exerted and less performance which resulted in negative efficiency. The mental effort is lesser than the performance, as a result of which the efficiency is positive.



Graph 1: Efficiency metric for control group

The efficiency graph shows a theoretical reference line for efficiency which is equal to 0. Any score that will fall above the 0 on the vertical line and has low mental effort score will results in high efficiency (Clark, Nguyen & Sweller 2006). The pre-test efficiency graph of the control group showed better performance than the pre-test. The mental effort has reduced in the post-test but it did not yield better performance scores. So the efficiency of both the tests falls in low efficiency area.

In contrast, the efficiency for the experiment group (graph 2) was negative in the pre-test. The efficiency graph shows that the mental effort was more than the performance in the pre-test. The post-test data however reflected that the mental effort was less than performance thus resulting in improved efficiency. The efficiency score values are low in number. It is because raw scores are converted to the Z score. Z scores convert the average of the score to zero. When 0 is considered a standardized scale, the Z score of performance and mental efforts are viewed against the Z score. The efficiency of the experiment group in the post-test is in the high efficiency zone of the graph. This confirms the hypothesis that if the instruction is modified to reduce the cognitive load, it will result in improved performance of the students.



Graph 2: Efficiency metric for experiment group

Two-tailed *t* test was run to analyse the performance of two groups on pre and post-test. The *t* test was conducted using SPSS version 22, and the experiment group's performance on the pre-test and post-test were compared. The *p* value (significance in the output) of the correlation of tests is .007. This is less than the standard *p* value of 0.05. For a statistical significance, *p* value has to be less than 0.05. Therefore it is concluded that the modified instruction resulted in improved performance of the experiment group.

Paired Samples Test Experiment Group

	Paired Differences					t	df	Sig. (2-tailed) *p* value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Post Test - Pre Test	**8.13500**	14.77505	2.79222	2.40583	13.86417	2.913	27	**.007**

Table 10: Paired Samples Test Experiment Group

For a *t* test to be of significance, results indicate that the experimental group has shown statistically significant improvement (p = .007) when given the cognitively modified instruction (mean = 61.3, SD = 22.1) than to the pre-test (mean = 53.2, SD = 20.2). The 95% confidence interval (95% CI) is 2.4 to 13.8. This means that if the same experiment is conducted 100 times, there is a 95% chance that the true value of the mean difference will fall in the CI range. It is concluded that the difference in marks is statistically significant, as was concluded by the deviation method used to find the efficiency metric. The 95% CI indicated the practical significance of the result. The effect size has not been calculated as the results meet the standard p < .05.

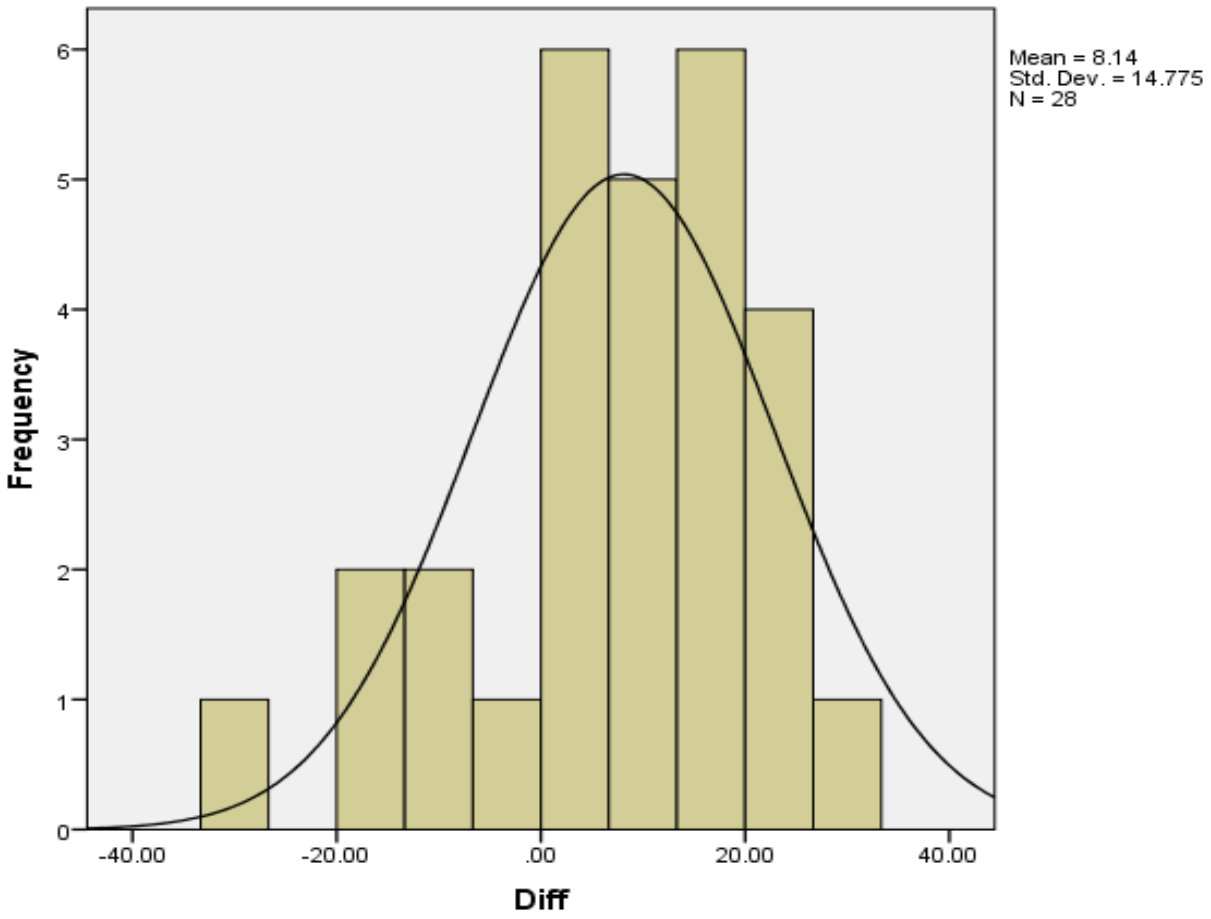
Paired Samples Test Control Group

	Paired Differences					t	df	Sig. (2-tailed) *p* value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Post Test - Pre Test	**-6.51250**	12.77461	2.60761	-11.90675	-1.11825	-2.498	23	**.020**

Table 11: Paired Samples Test Control Group

The paired data shows that the mean in the post-test of the experiment group has increased by 8 points. The mean of the control group has decreased by 6 points.

For a paired *t* test to be valid, the difference between the paired values should be normally distributed. The histogram of the paired data with the distribution curve shows that the *t* test is valid as the distribution of difference is normal with the mean of 8.14 and standard deviation 14.775. This concludes that the test results are practically significant as well.



Graph 3: Histogram of paired test with distributed curve

Post Test

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15.60	1	3.6	3.6	3.6
	21.90	1	3.6	3.6	7.1
	25.00	1	3.6	3.6	10.7
	34.40	1	3.6	3.6	14.3
	37.50	2	7.1	7.1	21.4
	43.80	1	3.6	3.6	25.0
	50.00	1	3.6	3.6	28.6
	56.30	2	7.1	7.1	35.7
	59.40	3	10.7	10.7	46.4
	62.50	3	10.7	10.7	57.1
	65.60	2	7.1	7.1	64.3
	68.80	1	3.6	3.6	67.9
	71.90	1	3.6	3.6	71.4
	81.30	1	3.6	3.6	75.0
	84.40	1	3.6	3.6	78.6
	87.50	3	10.7	10.7	89.3
	90.60	2	7.1	7.1	96.4
	93.80	1	3.6	3.6	100.0
	Total	28	100.0	100.0	

Table 12: Histogram values

Another related purpose of the study is to find out if the improvement in the vocabulary skills acquisition will impact the reading comprehension skills. During the instructional time, many activities designed combined both skills. Students were provided with short text passaged initially. Once they responded to these well, the texts containing more information were given. The basic expectation of enhanced vocabulary skills of the students comes from the assumption that if students will understand more words, they will be able to comprehend a text better (Burgoyne, Whiteley & Hutchinson 2011). Burgoyne, Whiteley and Hutchinson (2011, p. 345) opine that "vocabulary has been demonstrated to be strongly related to reading comprehension". They also state that children, who have weaker vocabulary skills, face significant constraints on the comprehension skills, both reading and listening. This argument put forward provides the researcher with the base to explore the impact of enhanced vocabulary skills on students' reading comprehension skills. Burgoyene et al. (2009) conducted a study to examine the lower attainment of second language in reading and reading

comprehension skills. They concluded that the lower level was not because of decoding difficulties but because of significantly low levels of the vocabulary.

The *t* tests were conducted to analyse the vocabulary and comprehension test of the experiment group. The mean statistics of the vocabulary pre-test reflect that students' vocabulary score has improved in the post test.

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Vocabulary Post-Test	36.7286	28	12.62575	2.38604
Vocabulary Pre-Test	29.025	28	13.5206	2.5552

Paired Samples Correlations

	N	Correlation	Sig.
Vocabulary Post-Test & Vocabulary Pre-Test	28	.753	.000

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed) *p* value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Vocabulary Post-Test - Vocabulary Pre-Test	**7.70357**	9.22242	1.74287	4.12749	11.27965	4.420	27	**.000**

Table 13: Paired Sample Test Experiment Group Vocabulary

The mean score has significantly improved (7.7) in the vocabulary post-test. The standard deviation was also better in range as compared to the vocabulary pre-test. The correlation between pre and post-test of vocabulary is .753 which is a strong correlation, being under +1. The *p* value is less than .05 which confirms that the result is statistically significant (mean = 53.2, SD = 20.2). Because of this, it can be concluded that there is statistically significant difference between the test taken before and after the modified instruction. Since the Paired vocabulary test statistics show that the mean number of post-test after the cognitively modified instruction was greater than the mean for the pre-test, it can be concluded that the students of experiment group were able to perform significantly better in the post-test

vocabulary. The 95% confidence interval (95% CI) is 1.7 to 11.2. It is concluded that the difference in marks is practically significant to confirm the hypothesis.

The paired *t* test for the comprehension test yielded following results.

Paired Samples Statistics

	Mean	N	Std. Deviation	Std. Error Mean
Comprehension Post-Test	31.764	28	12.7929	2.4176
Comprehension Pre-Test	30.739	28	12.8671	2.4316

Paired Samples Correlations

	N	Correlation	Sig.
Comprehension Post-Test & Comprehension Pre-Test	28	.631	.000

Paired Samples Test

	Paired Differences					t	df	Sig. (2-tailed) *p* value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Comprehension Post-Test - Comprehension Pre-Test	**1.0250**	11.0219	2.0829	-3.2488	5.2988	.492	27	**.627**

Table 14: Paired Sample Test Experiment Group Comprehension

The mean statistics of the comprehension pre-test reflects that students' comprehension scores improved in the post-test but the improvement was not significant statistically as the mean difference was 1.02. In addition to statistically less significant mean, the *p* value was more than 0.05. The results are statistically insignificant if the *p* value is more than 0.05. Since the results do not meet the standard $p < .05$ criterion of significance, it is concluded that the participants did not show significant improvement in comprehension skills. This leads to the conclusion that improvement in the vocabulary had no significant effect on the improvement of the comprehension skills of the students.

4.3 Qualitative Data Analysis

Lesson observations were conducted to validate if the instruction was delivered as it was planned. As mentioned in chapter 2, principles of three cognitive effects were used to modify the instruction. Lesson observations are essential part of the study, as the instruction was carefully designed based on cognitive effect, and its proper delivery was pertinent to the skill acquisition. The descriptive and evaluative notes for the observations were taken. The total instructional time of the study was 4 weeks, 6 lessons of 50 minutes duration per week. Out of 24 lessons, 20 lessons were observed. This is 83.4 % of total lessons delivered. The lesson observation notes (appendix P) reveal the findings which can be summed up as follows.

- The instruction in the class reflected the use of multimedia resources essential for instructional based on split-attention and modality effect.
- Students responded well to the interactive multimedia used during instruction. They were excited to use the digital tools to learn about words and their meanings.
- The redundancy effect was effectively employed when students were seated in the homogeneous groups.
- Students were able to perform the given tasks on time.
- To read a smaller chunk of a text and find the meanings of the words enabled students to understand the text better.
- Simple skills when mastered initially, led to a better performance on the complex tasks.

The complex task in vocabulary was to categorize the words into their grammatical function and use the word in a sentence reflecting its proper grammatical use. The element interactivity for this task was higher than finding the meanings alone. To achieve this complex skill, the instruction on grammatical function of the words was given to the students first. The word ‘swimming’ can be either used as a verb or as a noun. First, they learnt to categorize the words into their family. When the skill of proper categorization was obtained, they were asked to reflect this through use of the word in a sentence reflecting the grammatical function.

Another evaluation made out of the observations, which is not related to the observed areas, but is a result of the related instructional design, is that initially, for the students to shift from their daily routine was difficult. They were used to the regular instruction delivered by the teacher. It took them time to respond to a different instructional method. They responded well

once they were familiar with the new instructional style. To learn one skill at a time helped students perform better at a complex task. The evaluations made through lesson observations can be summarized using a table.

Findings	**No of lesson observations supporting the findings**	**%**
The instruction delivery was as per the instruction design	20	100%
Students were observed to be on task and engaged	18	90%
Students completed the given task on time	19	95%

Table 15: Qualitative Data Findings

4.4 Research Questions and Data Findings

The data findings answer the first research question in affirmation. These are analysed in detail.

Question 1

The main research question was that how will the cognitively modified instruction impact the vocabulary acquisition of grade two students with Arabic as first. The data analysis conducted above provides the answer that the modified instruction impacted the performance of the students positively. It is concluded that the instruction that was cognitively modified, led to better vocabulary acquisition of the students who were second language users of English. The mean difference of the vocabulary scores is both statistically and practically significant.

Secondary question 1

The first sub-question of the research was will students' overall subject achievement increase if they understood instruction better. This question is answered in affirmation. The analysis of results obtained through deviation model conclude that the students of the experiment group, who received the modified instruction, efficiency of their performance in the post-test increased as compared to that of the control group. This clearly was because of the impact of the modified instruction. The similar conclusion was supported by the *t* test analysis where

the post-test of experiment group had *p* value of less than 0.05. Thus the research concludes that the students' overall performance increased when they understand instruction better. The lesson observations confirmed similar conclusions where students completed the tasks on time as they understood the instruction better. This was also evident through the student engagement level during lessons. Lesson observations indicate that students were able to comprehend instruction better. As a result, the overall performance of the students was better as revealed by the gain of a mean of 8.1 points made by the experiment group in the post test.

Secondary question 2

The second sub-question of the research was will better acquisition of vocabulary help students improve their comprehension skills. The *t* test for the comprehension test of the experiment group reflected that the results were not statistically significant as the value of *p* was more than 0.05. The mean score of the comprehension post-test increased, but it was not significant. The results conclude that the improved skills in vocabulary did not have a significant effect on the reading comprehension skills of the students. The possible reason for this result can be explained that although vocabulary is an important element in understanding a text better, but comprehension skills involve other aspects such as inference, generalizations, and synthesis and analysis the information presented in a text (Burgoyne, Whiteley & Hutchinson 2011).

4.5 Evaluation

Instruction that is focused, and results from careful consideration of cognitive load, impacts students' learning positively (Clark, Nguyen & Sweller 2006; Sweller, Ayres & Kalyuga 2011). The results confirm that vocabulary skills of grade 2 students of second language improved when the cognitive load was reduced. The use of instruction in class that helped reduce the cognitive load resulted in better overall performance of the students.

The study is particularly interesting for the students with Arabic as a first language. The two languages are completely different and do not bear any similarities which can be an advantage for students of other languages such as French where two languages have many words similar in sound or meaning (Suarez & Otero 2013). For Arabic speaking children, learning English is very challenging. The language skills of these students proportionally impact their achievement in other content areas as well as the medium of instruction in Mathematics and Science is English. It is therefore essential to build sound language skills of the students in English from a younger age. The 7 year old students responded well to the

instruction and their overall performance on the test and specifically in vocabulary increased. It is concluded that the reduced cognitive load will help students acquire better vocabulary skills as compared to instruction which is not designed specifically taking into consideration the cognitive load.

Chapter 5 Conclusion

5.1 Summary of the Study

The study was conducted to explore the impact of a cognitively modified instruction on vocabulary acquisition of grade 2 students with Arabic as a first language. 54 students of grade 2 (age 7) were the participants of the study constituting the experiment and the control groups. The experiment group was given the modified instruction whereas the control group was not given any special treatment. It was hypothesized that the instruction that is modified to reduce the cognitive load, will impact students' performance positively. Study also explored the impact of increased vocabulary skills on reading comprehension skills of the student. The study was conducted over a time period of 4 weeks, with instructional time of 6 lessons of 50 minutes per week. The instruction was modified based on the principles of split-attention effect, modality effect, and redundancy effects. The control and experiment groups took a pre-test at the beginning of the instruction and post-test at the end of the 4 weeks' instructional time. The students also indicated the mental effort exerted during both tests through a 7 point Likert scale based on NASA TLX.

The research was experimental in design. The quantitative data was collected through pre and pot-tests scores, and the mental effort test scores. The qualitative approach of lesson observations was adopted to evaluate the quality of instruction and student responses to the assigned tasks. Two methods were employed to analyse the results. Deviation model was used to find the efficiency metric, which is the difference of Z scores of performance test and mental effort test. The paired *t* test was conducted to find statistical significance of the mean difference of post and pre-tests. The qualitative evaluations were made based on the observations conducted. The deviation model calculations indicated better efficiency of the experiment group in the post-test. The analysis of paired *t* test of the experimental and control group also concluded that when cognitive load during the learning process was reduced, the students' performance of vocabulary increased leading to over-all improved performance on post-test. It was also concluded that improved skills acquisition in vocabulary did not result in improvement in comprehension skills as the value of *p* was more than 0.05 on the paired *t* test of comprehension test scores.

5.2 Key Findings

The main purpose of the study was to find out how would the instruction impact grade 2 students' performance if the cognitive load was reduced during the learning process. The key findings of the study are as follows:

- The instruction carefully designed to reduce the cognitive load for the learners helped them acquire skills to perform complex vocabulary tasks, and improves students' performance.
- Improvement in vocabulary acquisition resulted when instruction was cognitively modified. The improvement in the vocabulary skills however did not have a significant positive impact in students' comprehension skills.
- When the students were provided with multimedia resources, they responded better to instruction. Providing students with the images of the words as well as short explanation helped them understand the words better. They were also able to write short explanations of the words to describe the meanings. Similarly, when a short text was given to the students to be read and pictorial images were available to relate the text with, it helped them comprehend the text better. Mayer (2005) supports the same finding.
- The split-attention effect had a positive impact only when the two resources used were essential to be consulted and interpreted at the same time. The two resources used containing same information will impose extraneous load, rather than reducing it. Sweller, Ayres and Kalyuga (2011) also support the same findings.
- It was more productive to create interactive learning environments while employing modality effect in instruction. This resulted in better student responses. Students used their ipads and laptops to connect to the teacher's board. They all were making speculation of the meanings and confirming or rejecting the suggestions made. They could respond more logically than during the oral discussion time of similar activity.
- The learning was better when interactive multimedia resources were used. The study suggests that students must be given enough time to manipulate the resources and make sense of what they are expected to do at their age.
- Use of animated videos to provide a better understanding of context was more helpful than only providing students with images. Students respond better to animated objects that they could see moving and talking rather than simple view of unanimated images.

- Modality effect was better employed in instruction when element interactivity was higher. Study suggests that low element interactivity task may impose more cognitive load if resources used are more than required.
- It is essential to determine the prior knowledge of the student before tailoring the instruction. A student who could read demanded different instructional level than the one who had difficulty in reading.
- Various aspects of student performance helped indicate the expertise level or the prior knowledge of the students. The teacher's evaluation that resulted from the routinely taken tests and their validity against the international benchmark tests taken by the students were good and valid sources.

5.3 Implications of the Study

In the world of education, the main aim is to ensure that learners are exposed to instruction in ways that will maximize their learning. The main challenge for instructional designers is to understand the element interactivity and its relationship with the cognitive loads. The less the element interactivity, reduced will be the cognitive load. Another challenge that an instructor may face is to determine the existing level of expertise or the prior knowledge of the learner. It is essential to determine what the learner has already acquired so that redundant information can be eliminated to reduce the cognitive load on the learner.

The process of learning is very important for the learner as well as for the teachers and the instructional designers. Learning process for a learner can fluctuate from being an easy one to a hard one (Sweller 1994). These fluctuations sometimes result from the amount of information that a learner is presented with at one point of time (Sweller & Chandler 1994). Considering the element interactivity during instructional planning is essential to expose students to the right amount of load during a task. The fluctuations in the learning process can be handled through balancing the element interactivity to reduce the cognitive load. Huffman and Hoffman and Schraw (2010) opine that alternative methods should be considered by the teachers to help students learn efficiently. Use of better learning resources and the way instruction is designed can help achieve that.

Learning a second language for the students whose first language is not similar to the second language, demands high cognition and is a complex learning process (Moussa 2008). The study explored the impact of modified learning on vocabulary acquisition of second language users. The three cognitive effects were employed to reduce the cognitive load so that the

process of vocabulary acquisition was accelerated. Element interactivity of the tasks was taken into consideration as well. This enabled the learner to 'understand' the information and not only 'learn' it. It is essential that students understand the information because this helps build schemas to perform complex tasks (Sweller 1994; Sweller, Ayres & Kalyuga 2011).

Selection of the material to be employed for teaching should be carried out thoughtfully and not randomly. The effects of cognitive load put forward certain principles that should be followed with specific instruction and content area. Resources used in one content area may not be suitable for another.

Students respond well to activities that involve complex learning and gain more knowledge. The vocabulary tasks that extend more than just finding the meanings were of more interest to the students. For improvement in comprehension skills vocabulary improvement may not have significant effects and other skills must be taught in relation. Further research is needed to find a positive relationship between vocabulary and comprehension skills.

5.4 Recommendations

Taking into consideration the results of the study, following recommendations can be put forward.

- The level of expertise or the prior knowledge of the individual learner must be determined and referred to while designing the instruction. The information which may be essential for one learner may become redundant for the other. If the prior knowledge is not taken into consideration, instruction may create a gap in learning for a struggling learner. On the other hand, if a learner had already acquired a skill, presenting redundant information will impose unnecessary cognitive load.
- For a younger age group, and specifically those learning a second language, it is helpful to use animated videos and interactive multimedia resources. These should be carefully employed in learning, especially when the element interactivity is higher for the task assigned. Complex tasks should be aided by effective deployment of appropriate instructional resources for better understanding and performance.

5.5 Further Study

The study can be further extended to examine the impact of cognitively modified instruction on English as second language students of grade 2 for a longer time period than 4 weeks. The effect of reduced cognitive tasks can also be examined on comprehension skills. The

cognitive effects employed in the study can also be used to designed instruction focused on comprehension. It will be interesting to explore the particular skills acquisition that would lead to improvement of comprehension skills other than vocabulary. The review of previous studies indicates that most of the cognitive load theory research has been conducted in content areas of Mathematics, Science, and Media Learning. There is no significant amount of research conducted in English as a second language acquisition (Sweller, Ayres & Kalyuga 2011). The cognitive effects and their impact on areas of language learning can be explored further.

The time span of the current study was only 4 weeks. Students took some time initially to get used to new methods of learning. Students at this age are used to their already developed class routines. It will be interesting to see the impact of the study for a longer time period. The initial time can be allocated to familiarize students with the instructional methods so that they are responsive and are at ease with the new methods.

5.6 Concluding Note

Second language acquisition is a challenging task for the second language users. To become better at language acquisition, it is essential to learn vocabulary and use it to extend the knowledge of the language. It is very important to design the instruction carefully for the second language users. The high level cognitive demands of learning a second language cannot be ignored. Cognitive load theory offers certain pedagogical practices and procedures that can be followed to design instruction that can help reduce the cognitive load thus freeing the capacity of the working memory to be used in further skills acquisition. These designs have mostly been experimented with subjects other than English as a second language. The study has attempted to test three of the cognitive loads that can be effective in designing the insertion for second language users of English. The results indicate that instruction with reduced cognitive load resulted in better vocabulary acquisition.

The efficiency of the students improves when they are exposed to the learning environment with less cognitive load. The learning environment provided must take into consideration the level of expertise of the students and should be supported by appropriate use of resources.

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Appendices

Appendix A: School administration Consent Form

Dear School Principal,

My name is Nazia Hadayat and I am a student at British University in Dubai. As a requirement of my Master in Education program, I am conducting a research. The study would explore the impact of cognitively modified instruction on grade 2 students with English as a second language. The study mainly aims to explore the impact on vocabulary and comprehension skills of the students. I would require your permission to conduct the study at your school. I would request you to grant me permission to conduct the study. The study will involve the following participant:

- Grade 2 students as the participants of control and experiment group
- The teachers teaching the classes that will be selected for participation

The study would involve the following:

- Pre and post-tests taken by the two participating groups
- The instruction for the experiment group will be modified as per the study requirements
- Use of specific resources required to be used for the experiment group
- Lesson observations of the experiment group

The study conducted is purely for educational purposes. The information of any kind that will be gathered will be kept confidential, including the names of the participants. The findings of the lesson observations and the tests taken will be used only for result analysis pertaining to the study.

Your cooperation by granting the permission will be highly appreciated. If you have any questions regarding the study, or would like to clarify any point, please feel free to contact me at 2013101039@student.buid.ac.ae

Sincerely,

Nazia Hadayat

Appendix B: Teacher Consent From

Dear Grade 2 Teacher,

My name is Nazia Hadayat and I am a student at British University in Dubai. As a requirement of my Master in Education program, I am conducting a research on grade 2 students at your school. The study would explore the impact of cognitively modified instruction on grade 2 students with English as a second language. The study mainly aims to explore the impact on vocabulary and comprehension skills of the students. I would require your help and cooperation in conducting the research. You are approached and requested for participation as you are the class teacher of the grade the study is intended for.

If you agree to participate in the research, I would request you to provide me with these.

- An evaluation of the current level of expertise or prior knowledge of the students
- Documents such as internal or external test and student portfolio as an evidence of you evaluation

Your support will be required in the followings:

- Delivering the instruction as planned
- Preparation of the resources as indicated in the planning
- Conducting in tests when required
- Correction of students' work

As a requirement of the study, your classroom will be observed almost on daily basis during English lessons of your class-teaching schedule. All the information obtained from your classroom will be confidential and you are assured of the following:

- The lesson observation is purely conducted for study purposes and does not aim at your evaluation as teacher or of your teaching strategies.
- The lesson observation findings are purely for the research purposes and data analysis, and will not be shared with any person, inside or outside the school.
- The performance of the students will be analysed only for the study purposes and will not be used for any evaluative purposes.

You are requested for participation on voluntary basis. You can either accept or reject to participate in the study. Your signing off the letter will indicate your agreement for participation and that you have read and understood the information contained on the letter.

If you have any questions regarding the study, or the information on the form, please feel free to contact me at 2013101039@student.buid.ac.ae

Sincerely,

Nazia Hadayat

Appendix C: Parent Consent Form

Dear Parent,

I am a student at British University in Dubai. I am conducting a research and your child has been a participant of a study conducted at his/her school. As a part of qualitative data evidence collection, the pictures of your child will be taken and these will be published in the dissertation for study purposes. Kindly sign the slip below and indicate your response regarding the request.

Your cooperation is highly appreciated in this regard.

☐ I agree for publishing my child's picture in the research.

☐ I don't agree for publishing my child's picture in the research.

Signature

Appendix D: Pre test

Vocabulary and Comprehension Pre-test (15 marks)

Grade 2 (Section: _____)
Name: _____

1- Match the following words with their meanings. ……./3

Words	Meanings
insects	shouting
rotten	not safe
dangerous	stain
screaming	crawling animals
scare	light wind
breeze	in bad condition

2- **Use the words from the box to complete the sentences. ……./3**

judge – wonderful – share – noises – noticed – quiet

1. I had a _____ time at the party. I enjoyed a lot.
2. In the zoo, I hear many animals making a lot of _____.
3. In the park, I _____ a small kitten that was hiding in the bush.
4. The class was noisy. The teacher asked everyone to be _____.
5. It is not good to _____ people. We should try to know them more before that.
6. I _____ my things with my friend. I like to help them.

3- Use the words to complete sentence. ……./2

1- bursting

_____

2- sprinkled

_____

3- suddenly

_____

4- sticky

_____

Comprehension

A Camping Trip
By Rachelle Kreisman

Ryan and his family went camping. They set up a tent and sleeping bags. Ryan's mom started to make a fire in the fire pit. Ryan and his sister, Lily, searched for sticks. The sticks had to be long with a point at the end. The family was going to roast marshmallows!

Ryan and Lily found the perfect sticks. Their mom opened a bag of marshmallows. Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited.

The marshmallows started to heat up. Ryan observed as the white treat turned brown. He knew that his marshmallow could not change back to white. He made sure not to burn it. Then Ryan removed the brown marshmallow from the fire. He waited a minute for it to cool. Then he took a bite. It was warm, gooey, and delicious!

A- Answer the following questions. ……./7

1- What did Ryan do with his family? (0.5)

a. He went camping.
b. He learned to cook.
c. He took a walk.

2- Ryan and Lily had to do some things before they could eat their roasted marshmallows. Which is the correct sequence of Ryan and Lily's actions? (0.5)

a. Held the marshmallows over the fire, found perfect sticks, put marshmallows on the stick.
b. Put marshmallows on the sticks, found perfect stick, held the marshmallows over the fire.
c. found perfect sticks, put marshmallows on the stick, held the marshmallows over the fire.

3- Read these sentences from the text. (1)

"Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited."

"The marshmallows started to heat up. Ryan observed as the white treat turned brown."

What conclusion can you draw based on this evidence.

a. Marshmallows will turn brown if they are outside for too long.
b. The heat from the fire made the marshmallows to change the colors.
c. Ryan's stick caused the marshmallows to change the colors.

4- Roasting the marshmallow caused it to change in a way that could not be undone. Which information from the text best supports this statement? (0.5)

a. "Ryan removed the brown marshmallow from the fire."
b. "Ryan observed as the white treat turned brown."
c. "He knew that his marshmallow could not change back to white."

5- What is the main idea of this story? (1)

a. Ryan and his family make a fire in a fire pit.
b. Ryan and his family roast marshmallows on their camping trip.
c. Ryan and his family learn about nature during their camping trip.

6- Read the sentences from the text. (1)

"The marshmallows started to heat up. Ryan **observed** as the white treat turned brown. He knew that his marshmallow could not change back to white."

What does the word "observed" mean?

a. heard
b. tasted
c. watched

7- Choose the answer that best completes the sentence. (0.5)
The marshmallow turned brown _____ Ryan held it over the fire.

a. so
b. because
c. but

8- What did Ryan do with his marshmallow after putting it at the end of his stick? (0.5)

_____

_____

9- How did the heat affect the marshmallow? (0.5)

_____

_____

10-Could Ryan make his marshmallow turn brown and gooey without using a fire? Explain your answer using evidence from the text. (1)

_____

_____

Appendix E: Post Test

Post Test
Vocabulary and Comprehension (15 marks)
Grade 2 (Section: _____)
Name: _____

1- Match the following words with their meanings. ……./3

Words	Meanings
tunnel	show off
curled	an underground passage
healed	having curves and curls
height	way, or track
brag	how tall something is
direction	cured

2- **Use the words from the box to complete the sentences. ……./3**

toward – tease – knowledge – curious – silence – darkness

1. I could not see because of _____ in the room.
2. He sat in the class in _____, without making any noise.
3. The scientist was _____ to examine the mysterious object.
4. Don't _____ me. I am very angry right now.
5. I went _____ my house, I forgot money at home.
6. He had _____ of how to operate laptop. He knows a lot about laptops.

3- Use the words to complete sentence. …….**/2**

1- illness

_____

2- imitated

_____

3- motion

_____

4- behavior

_____

Comprehension

A Camping Trip

By Rachelle Kreisman

Tara and Todd were at the farmer's market with their mom. The children liked looking at the fresh fruits and vegetables, homemade breads, and jars of jam.

Tara noticed Mr. Walsh at a table with big bags of potatoes. "Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

"What do you do with all those potatoes?" Todd asked.

"I sell them!" Mr. Walsh replied. "I sell some to grocery stores. I sell others to factories that make potato chips. The stores and factories pay me for my potatoes. They order more from me each year."

"Wow," said Tara. "What do you do with the money they pay you?"

"I use it to buy supplies for my farm," he answered. "I also use it to pay the people who work for me."

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, too!"

B- Answer the following questions. ……./7

1- Whom does Tara notice at a table with big bags of potatoes? (0.5)

a. Her mom
b. Todd
c. Mr. Walsh

2- Where does this story take place? (0.5)

a. At a grocery store
b. At a farmer's market
c. At Mr. Walsh's farm

3- Read these sentences from the text. (1)

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

What conclusion can you draw based on this evidence about Mr. Walsh?

a. Mr. Walsh grows carrots as well as potatoes.
b. Mr. Welsh sells some of his potatoes to grocery stores.
c. Mr. Welsh is a farmer.

4- Based on the story, what is best definition of a farmer's market? (0.5)

a. A farmer's market is a place where farmers go to buy the supplies they need for their farms.
b. A farmer's market is a place where farmers grow fresh fruits and vegetables.
c. A farmer's market is a place where farmers sell food they have grown themselves.

5- What is the main idea of this story? (0.5)

a. Tara and Todd learn about potatoes and farming when they visit a farmer's market.
b. Mr. Welsh uses the money he makes from selling his potatoes to buy supplies for his farm and to pay the people who work for him.
c. Tara's mom walks over to Mr. Walsh's table and asks him for two bags of potatoes.

6- Read the sentences from the text. (1)

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, **too!"**

Why might Mr. Walsh have used the word "too" at the end of the last sentence?

a. Because he grows carrots as well as potatoes
b. Because Tara's mom asked for two bags of potatoes
c. Because Tara also grows carrots

7- Read the sentences from the text. (1)

"I sell some to grocery stores. I sell others to factories that make potato chips. "

How can these sentences be combined?
a. I sell some to grocery stores after I sell others to factories that make potato chips.
b. I sell some to grocery stores, and I sell others to factories that make potato chips.
c. I sell some to grocery stores, so I sell others to factories that make potato chips.

8- What do Tara and Todd like looking at when they are at the farmer's market? (0.5)

_____

_____

9- What is Mr. Walsh's farm perfect for? (0.5)

_____

_____

10- It is likely that Mr. Walsh grows anything besides potatoes and carrots? Support your answer with evidence from the story. (1)

_____

_____

Appendix F: 7 Point Likert Scale

	Very very difficult	very difficult	Difficult	Not difficult	Easy	Very easy	Very very easy
							
How difficult was the pre-test							

	Very very difficult	very difficult	Difficult	Not difficult	Easy	Very easy	Very very easy
							
How difficult was the post-test							

Appendix G: Vocabulary List

Pre-test	Post-test
1. Insects	1. Tunnel
2. Rotten	2. Toward
3. Dangerous	3. Curled
4. Screaming	4. Healed
5. Scare	5. Height
6. Breeze	6. Brag
7. Sticky	7. Direction
8. Judge	8. Tease
9. Wonderful	9. Knowledge
10. Share	10. Illness
11. Noises	11. Curious
12. Noticed	12. Imitated
13. Quiet	13. Motion
14. Bursting	14. Darkness
15. Sprinkled	15. Silence
16. Suddenly	16. Behavior

Appendix H: Lesson Observation Form

Lesson Observation	
Setting: Observation # : Date/Time: Duration of observation:	
Descriptive notes	Evaluative notes

Appendix I: Anticipation: Building schemas

Use the following anticipation guide to preview a story before you read it. Before reading, mark whether or not you agree or disagree with each statement. After reading the story, read where did you find the answer of each statement, tell whether or not you were right, and reflect on what you found.

Statement	Agree/disagree	Evidence	Were you right?	Reflect
Passage is about how to grow apples.				
There will be a main character.				
Passage will be about benefits of apples.				

Appendix J: Exit Slip (assessment tool)

Write at least three words that you can recall the meanings of from today's lesson.

1. _____
2. _____
3. _____

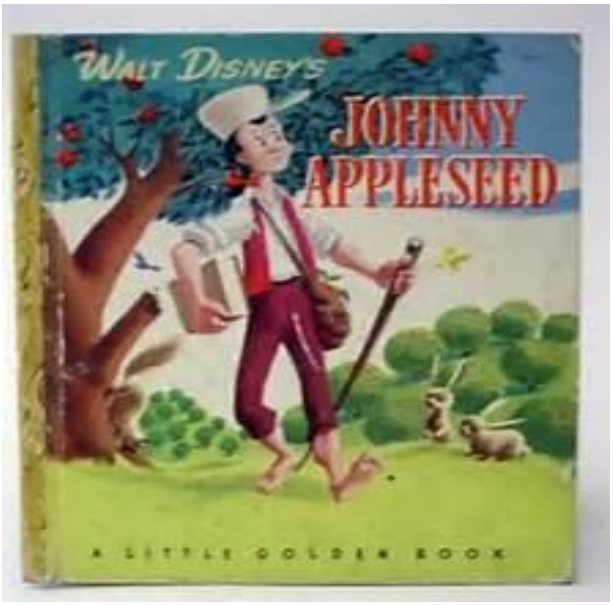
Can you use any of the words you learnt today, in a meaningful sentence?

_____

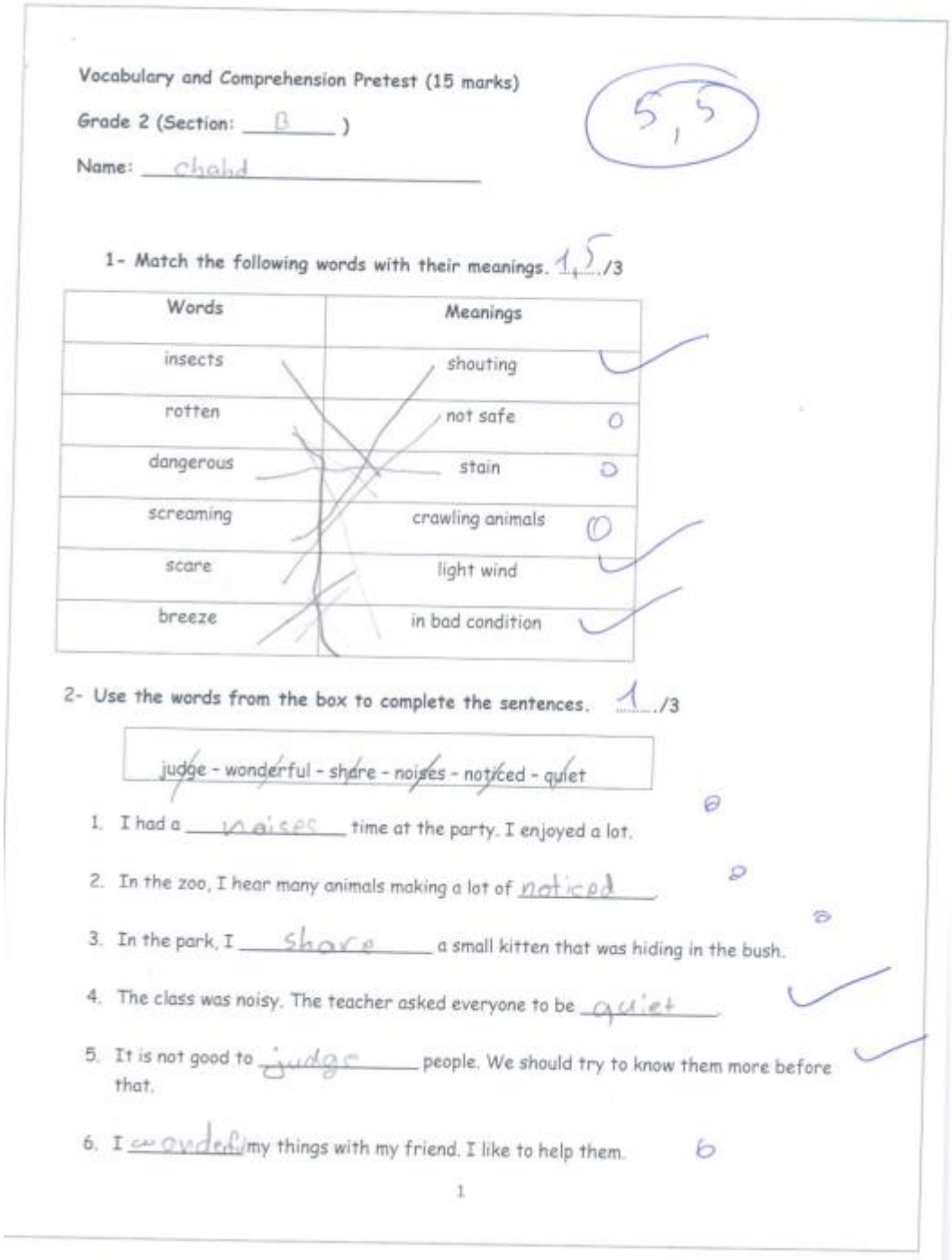
Name: _____

Appendix K: Sample Modality Effect

Meet a man who helped apples grow. He lived long ago. His name was John Chapman.
He liked to grow apples. He gave people apple seeds and small apple trees. Soon apple trees grew across the country.
Some people say he wore a tin pot on his head. They say he used it to collect berries to eat. Soon people called him Johnny Appleseed. That was a good name for a man who liked apples.



Appendix L: Sample solved and marked pre-tests and post-tests of the control group students



Vocabulary and Comprehension Pretest (15 marks)

Grade 2 (Section: B)

Name: Chahd

5,5

1- Match the following words with their meanings. 1,5 /3

Words	Meanings
insects	shouting
rotten	not safe
dangerous	stain
screaming	crawling animals
scare	light wind
breeze	in bad condition

2- Use the words from the box to complete the sentences. 1 /3

judge - wonderful - share - noises - noticed - quiet

1. I had a noises time at the party. I enjoyed a lot.
2. In the zoo, I hear many animals making a lot of noticed
3. In the park, I share a small kitten that was hiding in the bush.
4. The class was noisy. The teacher asked everyone to be quiet
5. It is not good to judge people. We should try to know them more before that.
6. I wonderful my things with my friend. I like to help them. 6

1

3- Use the words to complete sentence. 2 /2

1- bursting

the tv is bursting.

2- sprinkled

I sprinkled the cupcake.

3- suddenly

I was playing suddenly I put it at the bag.

4- sticky

The spider is sticky.

Comprehension

A Camping Trip
By Rachelle Kreisman

Ryan and his family went camping. They set up a tent and sleeping bags. Ryan's mom started to make a fire in the fire pit. Ryan and his sister, Lily, searched for sticks. The sticks had to be long with a point at the end. The family was going to roast marshmallows!

Ryan and Lily found the perfect sticks. Their mom opened a bag of marshmallows. Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited.

The marshmallows started to heat up. Ryan observed as the white treat turned brown. He knew that his marshmallow could not change back to white. He made sure not to burn it. Then Ryan removed the brown marshmallow from the fire. He waited a minute for it to cool. Then he took a bite. It was warm, gooey, and delicious!

A- Answer the following questions. ..... /7

1- What did Ryan do with his family? (0.5)

a. He went camping.
b. He learned to cook.
c. He took a walk.

2- Ryan and Lily had to do some things before they could eat their roasted marshmallows. Which is the correct sequence of Ryan and Lily's actions? (0.5)

a. Held the marshmallows over the fire, found perfect sticks, put marshmallows on the stick.
b. Put marshmallows on the sticks, found perfect stick, held the marshmallows over the fire.
c. found perfect sticks, put marshmallows on the stick, held the marshmallows over the fire.

3- Read these sentences from the text. (0.5)

"Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited."

"The marshmallows started to heat up. Ryan observed as the white treat turned brown."

What conclusion can you draw based on this evidence. (0.5)

a. Marshmallows will turn brown if they are outside for too long.
b. The heat from the fire made the marshmallows to change the colors.
c. Ryan's stick caused the marshmallows to change the colors.

4- Roasting the marshmallow caused it to change in a way that could not be undone. Which information from the text best supports this statement? (0.5)

a. "Ryan removed the brown marshmallow from the fire."
b. "Ryan observed as the white treat turned brown."
c. "He knew that his marshmallow could not change back to white."

5- What is the main idea of this story? (1)

a. Ryan and his family make a fire in a fire pit.
b. Ryan and his family roast marshmallows on their camping trip.
c. Ryan and his family learn about nature during their camping trip.

6- Read the sentences from the text. (1)

"The marshmallows started to heat up. Ryan **observed** as the white treat turned brown. He knew that his marshmallow could not change back to white."

What does the word "observed" mean?

a. heard
b. tasted
c. watched

7- Choose the answer that best completes the sentence. (0.5)
The marshmallow turned brown _____ Ryan held it over the fire.

a. so
b. because
c. but

8- What did Ryan do with his marshmallow after putting it at the end of his stick? (0.5)

_____

_____

9- How did the heat affect the marshmallow? (0.5)

_____

_____

10- Could Ryan make his marshmallow turn brown and gooey without using a fire? Explain your answer using evidence from the text. (1)

_____

_____

8,5

Post Test

Vocabulary and Comprehension (15 marks)

Grade 2 (Section: B)

Name: _____

1- Match the following words with their meanings. 1,5 /3

Words		Meanings	
tunnel	5	4 show off	0
curled	3	5 an underground passage	✓
healed	4	5 having curves and curls	0
height	2	1 way, or track	✓
brag	5	2 how tall something is	✓
direction	1	3 cured	0

2- Use the words from the box to complete the sentences. 2 /3

toward - tease - knowledge - curious - silence - darkness

1. I could not see because of darkness in the room.
2. He sat in the class in silence, without making any noise.
3. The scientist was toward to examine the mysterious object. D
4. Don't tease me. I am very angry right now. ✓
5. I went curious my house, I forgot money at home. 0
6. He had knowledge of how to operate laptop. He knows a lot about laptops. ✓

1

7.

3- Use the words to complete sentence. 2./2

1- illness

my first hade illness

2- imitated

my little imitateur

3- motion

I motion my hands into a Butterfly

4- behavior

Jeed. Ait's behavior in a Pby bad.

Comprehension

A Camping Trip
By Rachelle Kreisman

Tara and Todd were at the farmer's market with their mom. The children liked looking at the fresh fruits and vegetables, homemade breads, and jars of jam.

Tara noticed Mr. Walsh at a table with big bags of potatoes.

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

"What do you do with all those potatoes?" Todd asked.

"I sell them!" Mr. Walsh replied. "I sell some to grocery stores. I sell others to factories that make potato chips. The stores and factories pay me for my potatoes. They order more from me each year."

"Wow," said Tara. "What do you do with the money they pay you?"

"I use it to buy supplies for my farm," he answered. "I also use it to pay the people who work for me."

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, too!"

2

A- Answer the following questions. ..... 3 ...../7

1- Whom does Tara notice at a table with big bags of potatoes? (0.5)

a. Her mom
b. Todd
c. Mr. Walsh

2- Where does this story take place? (0.5)

a. At a grocery store
b. At a farmer's market
c. At Mr. Walsh's farm

3- Read these sentences from the text. (0.5)

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

What conclusion can you draw based on this evidence about Mr. Walsh? (0.5)

a. Mr. Walsh grows carrots as well as potatoes.
b. Mr. Welsh sells some of his potatoes to grocery stores.
c. Mr. Welsh is a farmer.

4- Based on the story, what is best definition of a farmer's market? (0.5)

a. A farmer's market is a place where farmers go to buy the supplies they need for their farms.
b. A farmer's market is a place where farmers grow fresh fruits and vegetables.
c. A farmer's market is a place where farmers sell food they have grown themselves.

5- What is the main idea of this story? (0.5)

a. Tara and Todd learn about potatoes and farming when they visit a farmer's market.
b. Mr. Welsh uses the money he makes from selling his potatoes to buy supplies for his farm and to pay the people who work for him.
c. Tara's mom walks over to Mr. Walsh's table and asks him for two bags of potatoes.

6- Read the sentences from the text. (1)

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, too!"

Why might Mr. Walsh have used the word "too" at the end of the last sentence?

a. Because he grows carrots as well as potatoes
b. Because Tara's mom asked for two bags of potatoes
c. Because Tara also grows carrots

7- Read the sentences from the text. (1)

"I sell some to grocery stores. I sell others to factories that make potato chips."

How can these sentences be combined?
a. I sell some to grocery stores after I sell others to factories that make potato chips.
b. I sell some to grocery stores, and I sell others to factories that make potato chips.
c. I sell some to grocery stores, so I sell others to factories that make potato chips.

8- What do Tara and Todd like looking at when they are at the farmer's market? (0.5)

fresh fruits
They like looking at fresh fruit

9- What is Mr. Walsh's farm perfect for? (0.5)

growing potatoes

10- It is likely that Mr. Walsh grows anything besides potatoes and carrots? Support your answer with evidence from the story. (1)

mr. Walsh does not grow anything else
why would they look at fresh fruits then?

Appendix M: Sample solved and marked pre-tests and post-tests of the experimental group students

Vocabulary and Comprehension Pretest (15 marks) 11/15

Grade 2 (Section: A)

Name: Aishatu Mohammed Bubba

1- Match the following words with their meanings. 3./3

Words	Meanings
insects	shouting
rotten	not safe
dangerous	stain
screaming	crawling animals
scare	light wind
breeze	in bad condition

2- Use the words from the box to complete the sentences. 3./3

judge - wonderful - share - noises - noticed - quiet

1. I had a wonderful time at the party. I enjoyed a lot.
2. In the zoo, I hear many animals making a lot of noises.
3. In the park, I noticed a small kitten that was hiding in the bush.
4. The class was noisy. The teacher asked everyone to be quiet.
5. It is not good to judge people. We should try to know them more before that.
6. I share my things with my friend. I like to help them.

1

3- Use the words to complete sentence. 2 /2

1- bursting

She has a bursting bag of candy.

2- sprinkled

I sprinkled the corn to my brother's Rooster.

3- suddenly

I was sting in my room suddenly someone open the door.

4- sticky

The boy's hand is so steky.

Comprehension

A Camping Trip
By Rachelle Kreisman

Ryan and his family went camping. They set up a tent and sleeping bags. Ryan's mom started to make a fire in the fire pit. Ryan and his sister, Lily, searched for sticks. The sticks had to be long with a point at the end. The family was going to roast marshmallows!

Ryan and Lily found the perfect sticks. Their mom opened a bag of marshmallows. Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited.

The marshmallows started to heat up. Ryan observed as the white treat turned brown. He knew that his marshmallow could not change back to white. He made sure not to burn it. Then Ryan removed the brown marshmallow from the fire. He waited a minute for it to cool. Then he took a bite. It was warm, gooey, and delicious!

A- Answer the following questions. ...1.../7

1- What did Ryan do with his family? (0.5)

a. He went camping.
b. He learned to cook.
c. He took a walk.

2- Ryan and Lily had to do some things before they could eat their roasted marshmallows. Which is the correct sequence of Ryan and Lily's actions? (0.5)

a. Held the marshmallows over the fire, found perfect sticks, put marshmallows on the stick.
b. Put marshmallows on the sticks, found perfect stick, held the marshmallows over the fire.
c. found perfect sticks, put marshmallows on the stick, held the marshmallows over the fire.

3- Read these sentences from the text. (0.5)

"Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited."

"The marshmallows started to heat up. Ryan observed as the white treat turned brown."

What conclusion can you draw based on this evidence. (0.5)

a. Marshmallows will turn brown if they are outside for too long.
b. The heat from the fire made the marshmallows to change the colors.
c. Ryan's stick caused the marshmallows to change the colors.

4- Roasting the marshmallow caused it to change in a way that could not be undone. Which information from the text best supports this statement? (0.5)

a. "Ryan removed the brown marshmallow from the fire."
b. "Ryan observed as the white treat turned brown."
c. "He knew that his marshmallow could not change back to white."

5- What is the main idea of this story? (1)

a. Ryan and his family make a fire in a fire pit.
b. Ryan and his family roast marshmallows on their camping trip.
c. Ryan and his family learn about nature during their camping trip.

6- Read the sentences from the text. (1)

"The marshmallows started to heat up. Ryan observed as the white treat turned brown. He knew that his marshmallow could not change back to white."

What does the word "observed" mean?

a. heard
b. tasted
c. watched

7- Choose the answer that best completes the sentence. (0.5)
The marshmallow turned brown SO Ryan held it over the fire.

a. so
b. because
c. but

8- What did Ryan do with his marshmallow after putting it at the end of his stick? (0.5)

.5
Ryan Put the marshmallow to the fir
the fire make the marshmallow turn brown.

9- How did the heat affect the marshmallow? (0.5)

.5
It turned the marshmallow to brown and gooey.

10- Could Ryan make his marshmallow turn brown and gooey without using a fire? Explain your answer using evidence from the text. (1)

1
No because the heat is the thing that will make the marshmallow turn brown

Post Test

Vocabulary and Comprehension (15 marks) 15/15

Grade 2 (Section: A)

Name: Aishatu

1- Match the following words with their meanings. 3 /3

Words	Meanings
tunnel	show off
curled	an underground passage
healed	having curves and curls
height	way, or track
brag	how tall something is
direction	cured

2- Use the words from the box to complete the sentences. 3 /3

toward - tease - knowledge - curious - silence - darkness

1. I could not see because of darkness in the room.
2. He sat in the class in silence, without making any noise.
3. The scientist was curious to examine the mysterious object.
4. Don't tease me. I am very angry right now.
5. I went toward my house, I forgot money at home.
6. He had knowledge of how to operate laptop. He knows a lot about laptops.

1

7.

3- Use the words to complete sentence. ...2.../2

1- illness

Her illness took her sight and hearing.

2- imitated

She imitated her friend

3- motion

She can't hear or talk so she make motion

4- behavior

She has a wild behavior.

Comprehension

A Camping Trip

By Rachelle Kreisman

Tara and Todd were at the farmer's market with their mom. The children liked looking at the fresh fruits and vegetables, homemade breads, and jars of jam.

Tara noticed Mr. Walsh at a table with big bags of potatoes.

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

"What do you do with all those potatoes?" Todd asked.

"I sell them!" Mr. Walsh replied. "I sell some to grocery stores. I sell others to factories that make potato chips. The stores and factories pay me for my potatoes. They order more from me each year."

"Wow," said Tara. "What do you do with the money they pay you?"

"I use it to buy supplies for my farm," he answered. "I also use it to pay the people who work for me."

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, too!"

A- Answer the following questions. ...../7

1- Whom does Tara notice at a table with big bags of potatoes? (0.5)

a. Her mom
b. Todd
c. Mr. Walsh

2- Where does this story take place? (0.5)

a. At a grocery store
b. At a farmer's market
c. At Mr. Walsh's farm

3- Read these sentences from the text. (0.5)

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

What conclusion can you draw based on this evidence about Mr. Walsh? (0.5)

a. Mr. Walsh grows carrots as well as potatoes.
b. Mr. Welsh sells some of his potatoes to grocery stores.
c. Mr. Welsh is a farmer.

4- Based on the story, what is best definition of a farmer's market? (0.5)

a. A farmer's market is a place where farmers go to buy the supplies they need for their farms.
b. A farmer's market is a place where farmers grow fresh fruits and vegetables.
c. A farmer's market is a place where farmers sell food they have grown themselves.

5- What is the main idea of this story? (0.5)

a. Tara and Todd learn about potatoes and farming when they visit a farmer's market.
b. Mr. Welsh uses the money he makes from selling his potatoes to buy supplies for his farm and to pay the people who work for him.
c. Tara's mom walks over to Mr. Walsh's table and asks him for two bags of potatoes.

6- Read the sentences from the text. (1) 1

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, too!"

Why might Mr. Walsh have used the word "too" at the end of the last sentence?

a. Because he grows carrots as well as potatoes
b. Because Tara's mom asked for two bags of potatoes
c. Because Tara also grows carrots

7- Read the sentences from the text. (1) 1

"I sell some to grocery stores. I sell others to factories that make potato chips."

How can these sentences be combined?

a. I sell some to grocery stores after I sell others to factories that make potato chips.
b. I sell some to grocery stores, and I sell others to factories that make potato chips.
c. I sell some to grocery stores, so I sell others to factories that make potato chips.

8- What do Tara and Todd like looking at when they are at the farmer's market? (0.5) .5

fresh fruits and vegetables, Homemade breads and jar of jam.

9- What is Mr. Walsh's farm perfect for? (0.5) .5

Potatoes.

10- It is likely that Mr. Walsh grows anything besides potatoes and carrots? Support your answer with evidence from the story. (1) 1

yes. barbecues they write fresh fruit and vegetable Homemade breads, and jar of jam.

Vocabulary and Comprehension Pretest (15 marks) 4.5/15

Grade 2 (Section: _____)

Name: May e 1

1- Match the following words with their meanings. 5 /3

Words	Meanings
insects	shouting
rotten	not safe
dangerous	stain
screaming	crawling animals
scare	light wind
breeze	in bad condition

2- Use the words from the box to complete the sentences. 1 /3

judge - wonderful - share - noises - noticed - quiet

1. I had a wonderful time at the party. I enjoyed a lot.
2. In the zoo, I hear many animals making a lot of noises
3. In the park, I ~~ish a~~ noticed a small kitten that was hiding in the bush.
4. The class was noisy. The teacher asked everyone to be quiet
5. It is not good to ~~a vie~~ judge people. We should try to know them more before that.
6. I ~~jude~~ share my things with my friend. I like to help them.

1

3- Use the words to complete sentence. ..../2

1- bursting

2- sprinkled

3- suddenly

4- sticky

Comprehension

A Camping Trip
By Rachelle Kreisman

Ryan and his family went camping. They set up a tent and sleeping bags. Ryan's mom started to make a fire in the fire pit. Ryan and his sister, Lily, searched for sticks. The sticks had to be long with a point at the end. The family was going to roast marshmallows!

Ryan and Lily found the perfect sticks. Their mom opened a bag of marshmallows. Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited.

The marshmallows started to heat up. Ryan observed as the white treat turned brown. He knew that his marshmallow could not change back to white. He made sure not to burn it. Then Ryan removed the brown marshmallow from the fire. He waited a minute for it to cool. Then he took a bite. It was warm, gooey, and delicious!

A- Answer the following questions. ...../7

1- What did Ryan do with his family? (0.5)

a. He went camping.
b. He learned to cook.
c. He took a walk.

2- Ryan and Lily had to do some things before they could eat their roasted marshmallows. Which is the correct sequence of Ryan and Lily's actions? (0.5)

a. Held the marshmallows over the fire, found perfect sticks, put marshmallows on the stick.
b. Put marshmallows on the sticks, found perfect stick, held the marshmallows over the fire.
c. found perfect sticks, put marshmallows on the stick, held the marshmallows over the fire.

3- Read these sentences from the text. (0.5)

"Ryan put one marshmallow at the end of his stick. Lily did, too. Then they carefully held their marshmallows over the fire and waited."

"The marshmallows started to heat up. Ryan observed as the white treat turned brown."

What conclusion can you draw based on this evidence. (0.5)

a. Marshmallows will turn brown if they are outside for too long.
b. The heat from the fire made the marshmallows to change the colors.
c. Ryan's stick caused the marshmallows to change the colors.

4- Roasting the marshmallow caused it to change in a way that could not be undone. Which information from the text best supports this statement? (0.5)

a. "Ryan removed the brown marshmallow from the fire."
b. "Ryan observed as the white treat turned brown."
c. "He knew that his marshmallow could not change back to white."

5- What is the main idea of this story? (1)

a. Ryan and his family make a fire in a fire pit.
b. Ryan and his family roast marshmallows on their camping trip.
c. Ryan and his family learn about nature during their camping trip.

6- Read the sentences from the text. (1) 1

"The marshmallows started to heat up. Ryan observed as the white treat turned brown. He knew that his marshmallow could not change back to white."

What does the word "observed" mean?

a. heard
b. tasted
c. watched ✓

7- Choose the answer that best completes the sentence. (0.5) .5
The marshmallow turned brown _____ Ryan held it over the fire.

a. so
b. because ✓
c. but

8- What did Ryan do with his marshmallow after putting it at the end of his stick? (0.5) .5

marshmallow over the fire and waited. ✓

9- How did the heat affect the marshmallow? (0.5)

10- Could Ryan make his marshmallow turn brown and gooey without using a fire? Explain your answer using evidence from the text. (1)

Post Test

Vocabulary and Comprehension (15 marks) 11.5/15

Grade 2 (Section: 2A)

Name: Hakeem

1- Match the following words with their meanings. 3./3

Words	Meanings
tunnel	show off
curled	an underground passage
healed	having curves and curls
height	way, or track
brag	how tall something is
direction	cured

2- Use the words from the box to complete the sentences. 2./3

toward - tease - knowledge - curious - silence - darkness

1. I could not see because of darkness in the room.
2. He sat in the class in silence, without making any noise.
3. The scientist was curious to examine the mysterious object.
4. Don't tease me. I am very angry right now.
5. I went toward my house, I forgot money at home.
6. He had knowledge of how to operate laptop. He knows a lot about laptops.

1

7.

3- Use the words to complete sentence. 1.5 /2

1- illness

Helen Keller was sad because of her illne

2- imitated

Helen Keller imitated her teacher.

3- motion

Her motion was slowly.

4- behavior

Her behavior was so rude.

Comprehension

A Camping Trip

By Rachelle Kreisman

Tara and Todd were at the farmer's market with their mom. The children liked looking at the fresh fruits and vegetables, homemade breads, and jars of jam.

Tara noticed Mr. Walsh at a table with big bags of potatoes.

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

"What do you do with all those potatoes?" Todd asked.

"I sell them!" Mr. Walsh replied. "I sell some to grocery stores. I sell others to factories that make potato chips. The stores and factories pay me for my potatoes. They order more from me each year."

"Wow," said Tara. "What do you do with the money they pay you?"

"I use it to buy supplies for my farm," he answered. "I also use it to pay the people who work for me."

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, too!"

2

A- Answer the following questions. ……./7

1- Whom does Tara notice at a table with big bags of potatoes? (0.5)

a. Her mom
b. Todd
c. Mr. Walsh

2- Where does this story take place? (0.5)

a. At a grocery store
b. At a farmer's market
c. At Mr. Walsh's farm

3- Read these sentences from the text. (0.5)

"Hi, Mr. Walsh," she called. "You have a lot of potatoes!"

"Yes," replied the farmer. "I have been growing potatoes for years. My farm is perfect for that."

What conclusion can you draw based on this evidence about Mr. Walsh? (0.5)

a. Mr. Walsh grows carrots as well as potatoes.
b. Mr. Welsh sells some of his potatoes to grocery stores.
c. Mr. Welsh is a farmer.

4- Based on the story, what is best definition of a farmer's market? (0.5)

a. A farmer's market is a place where farmers go to buy the supplies they need for their farms.
b. A farmer's market is a place where farmers grow fresh fruits and vegetables.
c. A farmer's market is a place where farmers sell food they have grown themselves.

5- What is the main idea of this story? (0.5)

a. Tara and Todd learn about potatoes and farming when they visit a farmer's market.
b. Mr. Welsh uses the money he makes from selling his potatoes to buy supplies for his farm and to pay the people who work for him.
c. Tara's mom walks over to Mr. Walsh's table and asks him for two bags of potatoes.

6- Read the sentences from the text. (1) 1

"But do you grow anything besides potatoes?" asked Tara.

Just then, Tara's mom walked over. "Mr. Walsh," she asked, "may I please have two bags of potatoes? And do you have any of your great carrots this week?"

"Yes, indeed," Mr. Walsh replied. "See, Tara, I grow carrots, **too**!"

Why might Mr. Walsh have used the word "too" at the end of the last sentence?

a. Because he grows carrots as well as potatoes
b. Because Tara's mom asked for two bags of potatoes
c. Because Tara also grows carrots

7- Read the sentences from the text. (1) 1

"I sell some to grocery stores. I sell others to factories that make potato chips."

How can these sentences be combined?

a. I sell some to grocery stores after I sell others to factories that make potato chips.
b. I sell some to grocery stores, and I sell others to factories that make potato chips.
c. I sell some to grocery stores, so I sell others to factories that make potato chips.

8- What do Tara and Todd like looking at when they are at the farmer's market? (0.5) .5

looking for fresh fruits

9- What is Mr. Walsh's farm perfect for? (0.5) .5

Planting Potatoes and carrots

10- It is likely that Mr. Walsh grows anything besides potatoes and carrots? Support your answer with evidence from the story. (1)

no, He have been growing potatoes for a years

4

Appendix N: Sample solved mental effort scale of pre-tests and post-tests of the control group students

Zahra Mahdi

	Very very difficult	very difficult	Difficult	Not difficult	Easy	Very easy	Very very easy
How difficult was the pre-test							✓

	Very very difficult	very difficult	Difficult	Not difficult	Easy	Very easy	Very very easy
How difficult was the post-test		✓					

Saeed Ali

Appendix O: Sample solved mental effort scale of pre-tests and post-tests of the experiment group students

Meera Hassan

	Very very difficult	very difficult	Difficult	Not difficult	Easy	Very easy	Very very easy
How difficult was the pre-test			✓				

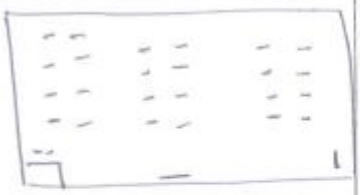
Jaska

	Very very difficult	very difficult	Difficult	Not difficult	Easy	Very easy	Very very easy
How difficult was the post-test							

Appendix P: Sample completed observation form

Lesson Observation: Word family

Setting: Grade 2A
Observation # : 18
Date/Time: 25th March 2016/ 10:00 - 10:50
Duration of observation:



Pair seating

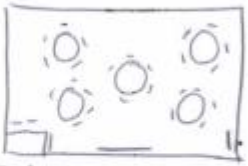
Descriptive notes	Evaluative notes
* Students took sometime to manipulate with the resources. They used digital resources more than the flash cards and visual images provided to aid learning.	- Students responded better to the digital resources.
* Exit slips reflect that most students have given correct responses by categorising words into word family table.	- The instructional methods used helped students perform better.
* Students could complete tasks with out much assistance and reliance on peers. They only had one member to refer to.	- The performance at an individual level is improving resulting in easier completion.

Lesson Observation

Vocabulary puzzles building

Setting: Grade 2A
Observation # : 13

Date/Time: 20th March 2016 / 8:00 - 8:50
Duration of observation: 50 minutes



Group Seating

Descriptive notes	Evaluative notes
*Students were quick to familiarize themselves on the ipads with the puzzle software used for the activity.	- Students respond better to interactive learning resources.
* Students in all groups could build and the puzzles. They shared the puzzles and solved them to reflect understanding of words under study.	- Collaboration lead to a positive learning out comes, and better skill acquisition.
* The tasks were completed on time. Five students on the Teachers desk (focus group) were assisted by the Teacher.	- With proper instructional strategies, students were able to complete the given tasks on time.

Tables

Table 6a and 6b: Performance test raw date of control and experiment group

6a

Control Group - Performance				
Participants	Marks Pre-test (Total 100)	Marks Post-test (Total 100)	Z Score - Pre Test	Z Score - Post Test
1	68.8	62.5	1.2	1.5
2	28.1	28.1	-0.8	-0.5
3	25.0	40.6	-0.9	0.2
4	25.0	21.9	-0.9	-0.9
5	34.4	34.4	-0.4	-0.1
6	75.0	68.8	1.7	1.9
7	18.8	18.8	-1.2	-1.1
8	31.3	25.0	-0.6	-0.7
9	75.0	53.1	1.6	-0.9
10	25.0	9.4	-0.9	-1.6
11	56.3	18.8	0.6	-1.1
12	43.8	25.0	0	-0.7
13	28.1	46.9	-0.8	0.5
14	50.0	31.3	0.3	-0.3
15	43.8	43.8	0	0.3
16	37.5	31.3	-0.3	-0.3
17	62.5	50.0	0.9	0.8
18	50.0	50.0	0.3	0.8
19	81.3	53.1	1.9	0.96
20	18.8	25.0	-1.2	-0.7
21	21.9	18.8	-1.1	-1.1
22	65.6	68.8	1.1	-1.9
23	43.8	31.3	0	-0.3
24	43.8	40.6	0	0.2

6b

Control Group - Mental Effort				
Participants	Marks /16 Pre-test	Marks /16 Post-test	Z Score - Pre Test	Z Score - Post Test
1	5	7	0.4	1.5
2	2	2	-1	-1
3	3	7	-0.5	1.5
4	2	2	-1	-1
5	4	4	0	-0.1
6	6	6	0.9	0.9
7	3	7	-0.5	1.5
8	4	3	0	-0.6
9	4	4	0	-0.1
10	1	1	-1.5	-1.7
11	4	4	0	-0.1
12	4	3	0	-0.6
13	3	3	-0.5	-0.6
14	7	5	1.4	0.4
15	5	6	0.5	0.9
16	2	2	-1	-1.1
17	7	3	1.5	-0.6
18	4	4	0	-0.1
19	2	4	-1	-0.1
20	7	5	1.5	0.4
21	7	7	1.5	1.5
22	5	4	0.5	-0.1
23	1	2	-1.5	-1.1
24	7	6	1.5	0.9

Table 7a and 7b: Mental effort test raw date of control and experiment group
7a

Experiment Group - Mental Effort				
Participants	Rating Pre-test	Rating Post-test	Z Score - Pre Test	Z Score - Post Test
1	6.0	6.0	0.8	0.9
2	3.0	3.0	-1.0	-0.7
3	4.0	5.0	-0.3	0.3
4	4.0	3.0	-0.3	-0.7
5	6.0	5.0	0.8	0.3
6	7.0	7.0	1.4	1.4
7	3.0	3.0	-1.0	-0.7
8	6.0	5.0	0.8	0.3
9	3.0	2.0	-1.0	-1.2
10	5.0	4.0	0.3	-0.1
11	5.0	7.0	0.3	1.4
12	6.0	5.0	0.8	0.3
13	5.0	5.0	0.3	0.3
14	6.0	4.0	0.8	-0.1
15	3.0	1.0	-1.0	-1.8
16	4.0	5.0	-0.3	0.3
17	7.0	7.0	1.4	1.4
18	3.0	2.0	-1.0	-1.2
19	7.0	7.0	1.4	1.4
20	3.0	2.0	-1.0	-1.2
21	6.0	5.0	0.8	0.3
22	3.0	2.0	-1.0	-1.2
23	6.0	6.0	0.8	0.9
24	4.0	2.0	-0.3	-1.2
25	4.0	4.0	-0.3	-0.1
26	2.0	3.0	-1.6	-0.7
27	2.0	4.0	1.6	-0.1
28	7.0	7	1.4	1.4

7b

Control Group - Mental Effort				
Participants	Marks /16 Pre-test	Marks /16 Post-test	Z Score - Pre Test	Z Score - Post Test
1	5	7	0.4	1.5
2	2	2	-1	-1
3	3	7	-0.5	1.5
4	2	2	-1	-1
5	4	4	0	-0.1
6	6	6	0.9	0.9
7	3	7	-0.5	1.5
8	4	3	0	-0.6
9	4	4	0	-0.1
10	1	1	-1.5	-1.7
11	4	4	0	-0.1
12	4	3	0	-0.6
13	3	3	-0.5	-0.6
14	7	5	1.4	0.4
15	5	6	0.5	0.9
16	2	2	-1	-1.1
17	7	3	1.5	-0.6
18	4	4	0	-0.1
19	2	4	-1	-0.1
20	7	5	1.5	0.4
21	7	7	1.5	1.5
22	5	4	0.5	-0.1
23	1	2	-1.5	-1.1
24	7	6	1.5	0.9