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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

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ABSTRACT: *This experimental study was conducted to find the impact of modified instructional strategies on the vocabulary and reading comprehension skills of grade 2 (7 year old) students of English as second language. 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 research hypothesis was 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). To test the hypothesis, specific instruction was tailored using principles of split-attention effect, modality effect, and redundancy effect to reduce the cognitive load. The experiment group was exposed to modified instruction for four weeks, 50 minutes lesson each day. Deviation method was used to analyse the impact of modified instruction on students' performance. Results on performance and mental effort tests of the experimental group indicated that reduced cognitive load helped increase the performance of students in vocabulary and comprehension acquisition. 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. The key theories consulted were theory of evolution, cognition, schema, and cognitive load theory.*

KEYWORDS: Cognition, Second Language Acquisition, Cognitive Load Effects, Efficiency

INTRODUCTION

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) which 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). Instructional design plays a significant role in students' learning and their success. This is why every school takes a great care to design instruction. Students' learning will be impacted if the instruction will impose extra load on cognition (Kirschner 2002). Institutions all over the world aim at hiring qualified teachers and spend a lot of money on teacher training. Both factors,

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instructional design and delivery of the instruction, need to work in harmony to impact students' learning positively.

Sweller, Ayres and Kalyuga (2011) emphasized 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.

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 aquatically learns to listen and process information in his first language. In contrast, biologically secondary knowledge is acquired with conscious effort (Geary 2008). If learning to listen and speak in the first language is part of natural learning, reading and writing are not. Geary (2007, p. 43) 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 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. 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 and resources are used to present information. This load is extraneous in nature, so it is called extraneous cognitive load. (Kalyuga 2011; Sweller, Ayres & Kalyuga 2011)

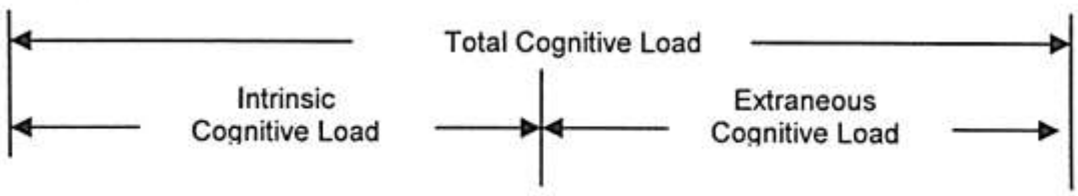

Figure 1: Intrinsic and extraneous cognitive loads (Chong 2005, p. 108)

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The third category of load was added to CLT at a later stage (Sweller, van Marrienboer & 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). Students struggle to learn an additional language which is different than their first language. 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.

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. 1. Will students' overall subject achievement increase if they understood instruction better? 2. Will better acquisition of vocabulary help students improve their comprehension skills? 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). It is expected that the experiment group will show better performance in the post test as compared to the control group.

The assumptions made in the study are that the experiment and control group, in regular classroom setting are taught in similar way. This will allow examining 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.

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 Merienboer & Sweller 2005). 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). 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."

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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 Merienboer & 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.

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.

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. For 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. Sweller (1994) and Sweller and Chandler (1994) conclude that the following aspects should be considered while measuring the element interactivity of a task: Existing knowledge of the learner, Numbers of elements simultaneously required to perform the task. Knowledge development of individuals occurs in line with the aspired tasks and how that would fit into a specific context. David (2017) argues that knowledge converges towards the specific tasks that may have relevant value in a context.

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Measuring Cognitive Load

Measuring cognitive load is essential to cognitive load theory and research related to that (Ayres & Pass 2012). 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.

Research Related Studies

Most research carried out so far, had been focused on reducing the cognitive load in mathematical studies. The current study however addresses the similar issues in second language acquisition. 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, can be one reason for more focus on mathematical studies. 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 (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 given the 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 was added. 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. Kalyuga (2007, p. 515) in his review of studies conducted on expertise reversal effect confirms that the longitudinal studies

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conducted were supportive of the expertise reversal model where the cognitive load was reduced and students' performance 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.

RESEARCH DESIGN AND METHODOLOGY

The research, experimental in design, employs three cognitive effects to modify instruction. The experiment group received instruction that was modified as per the three effects whereas the control group was exposed to regular instruction. Both groups took a pre-test to determine the current performance level. 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.

The Setting and Sample of the Research

The research was conducted in an American curriculum school of Dubai, UAE. Total students of grade 2 were 106, enrolled in four sections. 52 out of 106 students (52 %) were the research participants. The first language of these students was 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.

Table 1: The study sample

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

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

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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 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.

To measure the mental load, a 7 point Likert scale was used. Pass and van Marrienboer (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. 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. 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.

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 so that they could represent a real reflection of the mental effort exerted during the task. Non-participant lesson observations were used 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).

Data Analysis

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 scores were obtained to use a standardized scale for result analysis.

Efficiency metric

Efficiency metric 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.

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

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

Lesson observation

Lesson observation findings and descriptions were qualitative 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 plan format with descriptive and evaluative notes was prepared taking into consideration the parameters presented by Gay, Mills, and Airasian (2012, p. 382-386). The evaluations were made to see if the instruction delivered was reflective of the cognitive effect used. Students' engagement in lesson was observed along with their response to the given task.

RESULT, ANALYSIS AND DISCUSSIONS

Quantitative Data Findings

The raw scores of the performance and mental effort tests were used to calculate the mean and standard deviations. Both variables are essential for calculating the Z scores.

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.

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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 scores. 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. 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.

Control Group

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

Table 6: Z score and Efficiency of the control group

Experiment Group

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

Table 7: Z score and Efficiency of post-test of experiment group

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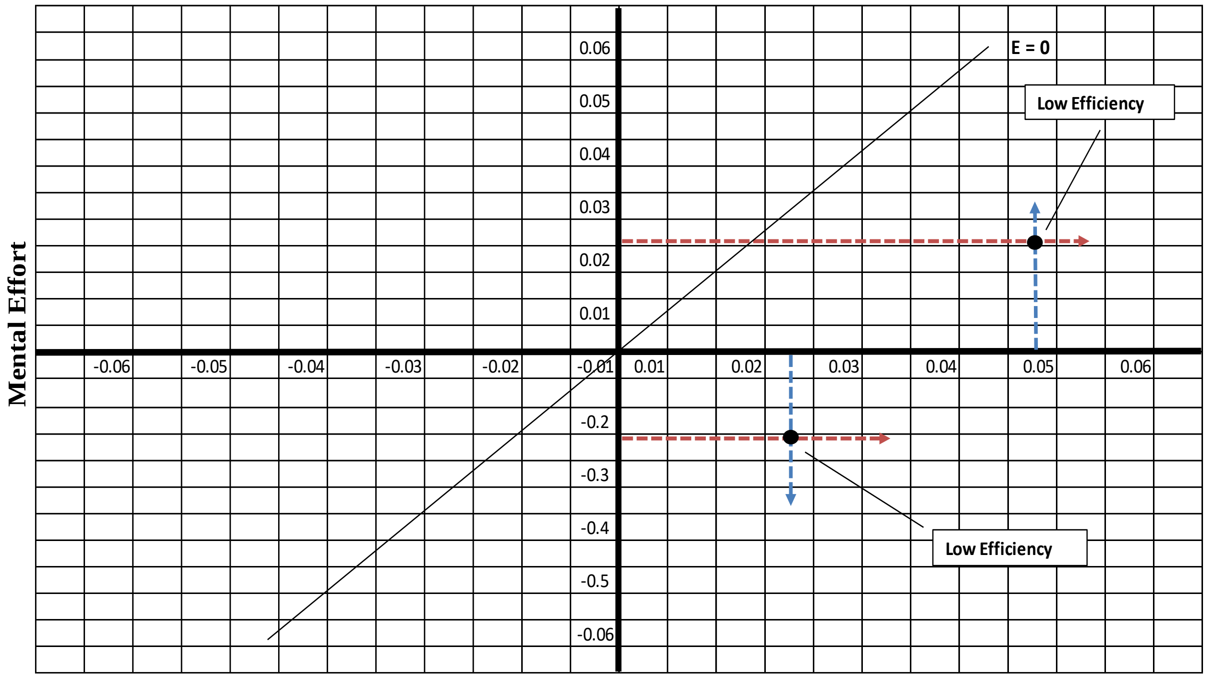
Comparing the values presented in table 6 and 7, it can be concluded that the control group participants have exerted more mental effort in pre-test and pot-tests. The overall efficiency score is negative. Mental effort however was reduced in the post-test but performance also decreased. In comparison, 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 and 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.

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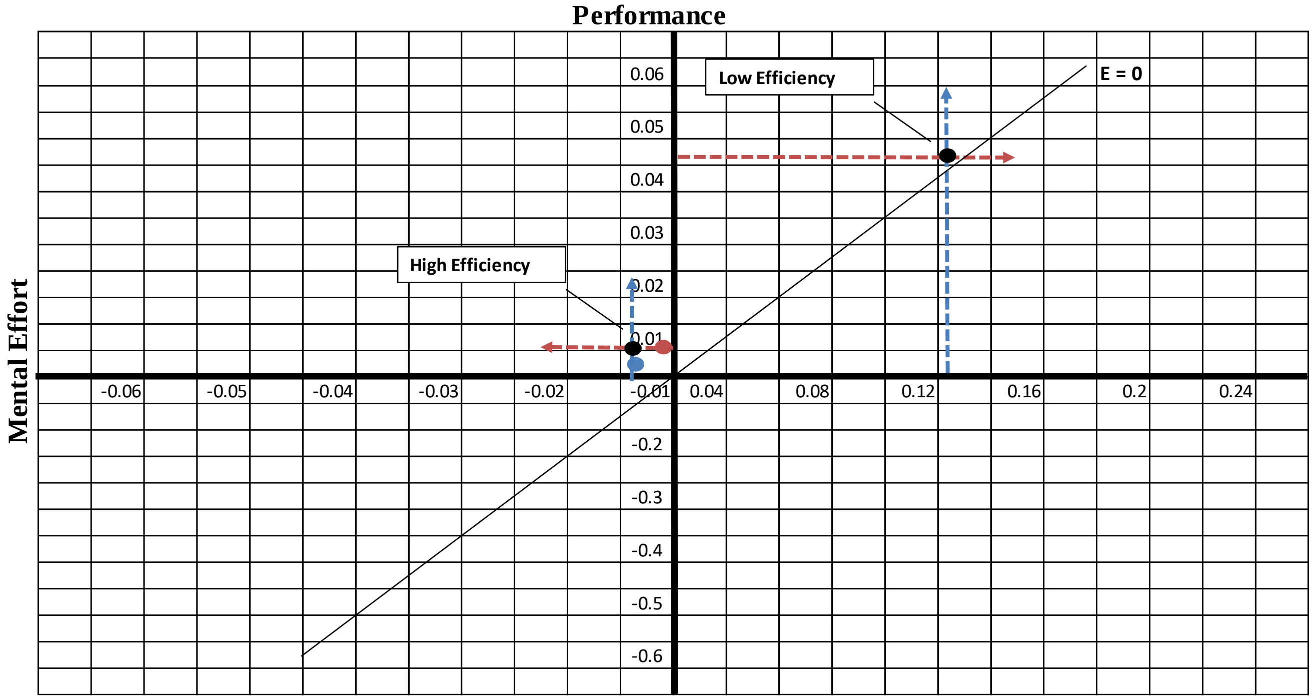

Graph 2: Efficiency metric for experiment group

Two-tailed *t* test was run to analyse the performance of two groups on pre and post-test. The *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							Sig. (2-tailed) *p* value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	t	df	
Post Test - Pre Test	**8.13500**	14.77505	2.79222	2.40583	13.86417	2.913	27	**.007**

Table 8: Paired Samples Test Experiment Group

Paired Samples Test Control Group

	Paired Differences							Sig. (2-tailed) *p* value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference: Lower	Upper	t	df	

Table 9: Paired Samples Test Control Group

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Post Test - Pre Test	**-6.51250**	12.77461	2.60761	-11.90675	-1.11825	-2.498	23	**.020**

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.

Another related purpose of the study is to find out if the improvement in the vocabulary skills acquisition will impact the reading comprehension skills. 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 if children, who have weaker vocabulary skills, face significant constraints on the comprehension skills, both reading and listening. The ***t*** tests were conducted to analyse the vocabulary and comprehension test of the experiment group.

Table 10: 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. It can be concluded that there is statistically significant difference between the test taking before and after the modified instruction.

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

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**

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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 11: Paired Sample Test Experiment Group Comprehension

The mean statistics of the comprehension test reflect that students' comprehension score has improved in the post test but the improvement is not significant statistically as the mean difference is 1.02. In addition to statistically less significant mean, 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 have not shown significant improvement in comprehension after the treatment given to them thus concluding that improvement in the vocabulary had no significant effect on the improvement of the comprehension skills of the students.

Qualitative Data Analysis

Lesson observations were conducted to validate if the instruction was delivered as it was planned. Principles of three cognitive effects were used to modify the instruction. Out of 24 lessons, 20 lessons were observed, 83.4 % of total lessons delivered. The descriptive and evaluative notes for the observations were taken. Observations indicated that 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 enable students to understand the text better. Simple skills when mastered initially, led to a better performance on the complex tasks.

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 12: Qualitative Data Findings

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

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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.

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.

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 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.

CONCLUSION

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 a positive answer to this question. 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. The first sub-question of the research was will students' overall

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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 second sub-question of the main research question 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). 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 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). It is very essential that students understand the information presented 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.

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

- It is essential that the level of expertise or the prior knowledge of the individual learner is determined. Teachers, while designing the instruction, must take that into consideration. 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 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.

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 for 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.

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