Cognitive Skills Reflection and Distribution in EFL Program Testing

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Abstract—The present study aims at figuring out the extent to which the low-order cognitive skills (LOCS) and high-order cognitive skills (HOCS) are reflected and systematically distributed in the first and eighth levels exam question papers. The study adopts the assumption that, critical thinking skills and creative thinking skills are adequately reflected and distributed in the exam question papers based on Bloom's Taxonomy of the Learning Behavior. The tool used for data collection is a check list containing cognitive domain order which is based on Bloom's Taxonomy. The goal is to ascertain whether questions at level 1 and level 8 offered in English language program in the College of Science and Arts in Mahayel Asir are adequately adjusted to the taxonomy. The descriptive and analytical method is applied to analyze the data. The researchers reviewed relevant literature and assessed similar results. The findings of the study revealed that lower-order cognitive skills (11.77%). On the other extreme, lower-order cognitive skills in level 8 (93.86%) are mostly used in the question papers more than higher- order cognitive skills (6.14%). There are adequate distribution and reflection of cognitive skills in level 1 exam questions. This is not the case as in level 8 where the focus was wholly based on the lower-order at the cost of the higher-order cognitive skills.

Index Terms-bloom taxonomy, distribution, EFL, higher-order and lower-order thinking testing

I. INTRODUCTION

In the year 1956, Dr. Benjamin S. Bloom (An American psychologist and educator) along with a group of educators, originated Bloom's Taxonomy of Educational Objectives. This classification was built on the basis of the work of Hilgenheger (1993), a German philosopher-psychologist who developed a five-steps learning model comprising: preparation, presentation, comparison and abstraction, generalization, and application. The classification is seen as a framework for facilitating and exchanging tests questions among teachers of different faculties. The objective is to create question banks that measure same educational objectives (Andrich (2002). The taxonomy includes a chain of six integrated orders of cognitive skills. Nicholas and Leame (2003) demonstrated that Bloom's taxonomy is seen as a scaffolding device or stair steps that students use to move from down to top. Each stair step backs then next one that follows it. This means that acquiring one cognitive order facilitates the acquisition of the other. The first cognitive level is labeled as knowledge dimension (McNett & Harvey 2003). It addresses four types of knowledge; factual, conceptual, procedural, and metacognitive knowledge (Radmehr & Drake 2018). Knowledge level requires the recalling, remembering, and retaining of information without further thinking process. It is the base upon which the other cognitive orders rest. The second cognitive level is comprehension. This level is defined as the ability to grasp the meaning of objects and transform the items from one position to another such as: translating words into numbers and vice versa. The third cognitive level is called application. It is defined as the competency to use acquired knowledge in real situations. It is the capacity to apply rules, theories, terms, and laws in proper modes. The fourth cognitive order is analysis. It is the ability to break down a subject into its basic structural elements. The fifth cognitive level is synthesis. It is the ability to use elements together to create a new entity. The sixth cognitive order is evaluation. It is the highest order of cognitive skills that enables students to manifest judgment and criticism on the value of something. Cognitive order skills presented in this study stand for low-order cognitive skills (LOCS) and higher-order cognitive skills (HOCS). The former, as Adli & Mahmoudi (2017) refer to is the form of thinking that involves recalling and memorizing information, whereas the latter involves analysis, synthesis, and evaluation of conceptions and procedures. Thus, the higher cognitive skills (henceforth) higher-order thinking is an umbrella that incorporates creative thinking, critical thinking and problem solving. Creative thinking is the capacity that enables learners to create unique ideas; generate ideas that others could not think of; deal with things in unusual ways; view a problem from different angles, etc. Similarly, critical thinking is the competency that enables learners to search for evaluation, clarity, consistency, precision, accuracy, justification, relevancy, and truth in everything (Piaw 2016). To sum up, both critical and creative thinking lead to the process of problem solving which is considered as the ultimate function of higher thinking. The present paper comprises ten sections. The following section is wholly devoted to the literature relevant to the study. The

aim here is to have snapshots of the main concepts and to see the relationship among them. The concept of higher thinking which includes creative thinking, critical thinking and problem solving are presented. The second section is about the research questions along with hypotheses. The third section presents the research design whereas the fourth section tackles data collection. The fifth section is about data analysis along with the sixth section which is about the method used. The seventh section addresses the results obtained. The eighth section is assigned for the discussion. The ninth section includes the conclusion whereas the tenth section offers the recommendations. The final section brings about the limitations of the research as well as proposes gaps to be addressed in future studies.

II. LITERATURE REVIEW

A. Low-order Cognitive Skills Distribution in the Exam Papers

Cognitive skills, whether they are low or high, are essential in high education. At the early stages, the LOCS including memorization and gain considerable proportion. The previous studies reviewed show consistency on the application of the first phase of the theory. It includes LOCS. That is to say; questions testing student's knowledge through their cognition abilities to remember, recall and memorize the items in question are applied in all the studies. Bloom's taxonomy is used by Soleimani & Kheiri (2016) to examine the quality of the exercises and assignments provided to Iranian MA and PhD students. The study found out that LOCS are used more in MA testing classroom activities while HOCS are never used. On the other hand, LOCS are never used in PhD testing classroom activities. Bloom's Taxonomy of Educational Objectives is used by Mohsen et al., (2010), Miyazoe & Anderson (2010) to investigate why the introductory biology courses are widely criticized for overemphasizing LOCS rather than HOCS. They quantify the cognitive level of learning targeted by the faculty in introductory-level biology courses. The investigation reveals that the assessment items used overwhelmingly target lower cognitive levels; however, the cognitive level of articulated course goals is not predictive of the cognitive level of assessment items. Their study also shows that there is no influence of course size or institution type on the cognitive levels of assessments concluding that the findings support the claim that introductory biology courses emphasize facts more than HOCS. In another similar study, De Waelsche (2014) and DeWaelsche (2015) investigate whether the higher-level questioning in studentcentered activities is valid enough to elevate critical thinking and increase student engagement among Korean university English majors. The study focuses mainly on exploring difficulties associated with reluctance among students to speak or share opinions in class because of sociocultural influences in the classroom. Although the studies reviewed are based on different subjects, many of them, in accordance with Soleimani & Kheiri (2016), Athanassiou (2003), Zoller & Tsaparlis (1997) and Tammy Long et al., (2010), are subjected to tests that measure LOCS rather than HOCS. Zoller believes that LOCS-orientation in teaching and the extent of prior examination preparation and examinations that contain items of both types is the main factors behind poor performance among the students.

B. Higher-order Cognitive Skills Distribution in the Exam Papers

The HOCS, defined above, are extremely crucial in the realm of higher education. This could obviously be seen in the relevant studies reviewed. Soleimani & Kheiri (2016), Ryan (2014), Ryan (2018), Marzban (2014), Adli (2017), Athanassiou (20 03), A. Ranjbara et al, (2007) and Marzban & Jalili (2014) emphasize the fact that the test given to their targets measure HOCS. Soleimani (2016) notices a systemic pattern in the distribution of the order of thinking skills of Bloom's Revised Taxonomy in postgraduate activities and assignments. Soleimani postulated that activities and assignments given to postgraduate students lead both to LOCS and HOCS. Marzban (2014) examined problem-solving in writing skills on the formulation stage of writing among Iranian EFL learners. The study investigates the frequency of solving, and the amount of time devoted to solving formulation problems in general and type of problems. For a period of in six weeks, learners were taught how to ask and answer questions in English based on their textbook using keywords and sample questions stem from Bloom's (1956) Taxonomy of Educational Objectives (cognitive domain). The aim is to develop their critical thinking. The results of Marban's study reveal that the treatment of the study is effective in increasing the level of critical thinking. He also found out that the treatment leads to an increase in the time spent on formulating problem-solving. According to the study, it is obvious that there is more time devoted to teaching questioning that leads to upgrading rather than compensating class of problems. However, the treatment does not have any significant effect on the frequency of solving formulation problems. De Waelsche (2015) conducted two separate studies sharing their targets views as to the validity of higher-level questioning in student-centered activities to elevate critical thinking and increase student engagement. The study shows that the student participation and critical thinking activities are negatively affected by cultural and institutional factors, in addition to limitations in English language proficiency. He argues that when students possess adequate English language skills and when they are challenged to do so in dialogues they will overcome sociocultural obstacles and successfully engage in group conversations with peers (DeWaelsche, 2015). In another study, Ryan (2014) found out that language test candidates not only have strong opinions (both positive and negative) about the tests they take, but they also have a strong desire to share those opinions with test developers. Ryan believes that this type of feedback can then be used to substantially improve future tests, thereby helping to enhance the validity of the test system.

Athanassiou (2003) investigated the use of Bloom's Taxonomy as a metacognitive framework for a student-centered management class adopting a six-level classification system using observed student behavior to infer the level of cognitive achievement. Based on suggested uses of Bloom's Taxonomy, he surveyed thinking within general education and within management education. Through an Empirical evaluation, he investigated the taxonomy's effect on student achievement. It is found out that in each class the difference between the median score of the students who demonstrated improvements and the median score of the students who demonstrated a decline is significant and positive. There is repeated attention given by students to the steps of Bloom's Taxonomy that increases their propensity to apply higher levels of conceptual sophistication to their work. More specifically, it is noted that in the IM class there was an actual decrease in performance on Bloom's scale between the first and the second observation. This may be explained as a learning effect. However, after each of the subsequent two periods of emphasis of Bloom's concepts, the class's performance improves significantly.

III. RESEARCH METHODOLOGY

The following section includes the methodology followed to conduct the present study.

A. Research Questions and Hypotheses

The questions of the present research are:

- 1. what extent the Low-order and High-order Cognitive Skills are reflected in the first and eighth terms exams?
- 2. Are the Low-order and High-order Cognitive skills adequately distributed in the first and eighth terms exams?

B. The Null Hypotheses Derived from the Research Questions above Were:

- 1. H1: Low-order and High-order Cognitive Skills are reflected in the exam papers.
- 2. H1a: Low-order Cognitive Skills are adequately distributed in the exam scripts.
- 3. H1b: High-order Cognitive Skills are adequately distributed in the exam scripts.

IV. DATA COLLECTION

The present study adopts a quantitative approach in which mathematical, computational, and statistical methods are used. To obtain numerical data, a structured check list of low-order and High-order Cognitive behaviors based on Bloom's Taxonomy of Educational Skills is designed. The required data for the study; are exam questions for two different levels in an EFL program. The tables below show the data collected from level 1 and level 8.

TABLE 1

		TEST QUESTIONS	DISTRIBUTION AND REFI	ECTION IN LEVELS	1&8				
Levels	Course code		Lower order	Higher order					
		Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation		
Level-1	110Eng-3	What (6) Write	Check, Select True/false						
	111Eng-3	Define, fill, match	True/false (2) circle						
	112Eng-3	Put, fill, correct Complete (2)				Join, make Write (2)			
	113Eng-3	Complete (4)	Circle (2) Correct			Make			
Leve-8	423Eng-3	Define, give (3)	True/false Discuss				Explain		
	425Eng-3		What (2) how Which, choose (3)	Write an essay		Compare			
	427Eng-3	Define, give (2) What2	True/false	Use			Explain		
	433 Eng-2	define, list, give Mention (3), what (2) State (2) write	Discuss (5)	Choose					
	441Eng-2	Mention, complete		Translate (6)					

Level=Semester; Lower- order (LOCS)=Knowledge, Comprehension, Application.; Higher-order Cognitive Skills (HOCS) = Analysis, Synthesis and Evaluation.

V. DATA ANALYSIS

The descriptive and analytical methods are applied to analyze the research question as to the extent in which the Low-order and High order Cognitive Skills are reflected in the first and eighth terms exam scripts. The main data source of this study is the test questions offered in level 1 & level 8. There are four tests assigned for level 1 and five tests for level 8. The test questions are classified according to Bloom's Taxonomy of Educational Objectives (cognitive orders). An independent samples T. test is used to show if there are any significant differences supposed be found between the two levels.

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		TREQUEN	CIES AND I EKCI	SNIAOES OF COOR	TITVE ORDERS IN	LEVELS ICC 0		
Bloom's Tax	conomy of cognitive orde	rs					Total	
Levels	Low order	Freq.	Perc. (%)	High order	Freq.	Perc. (%)	Freq.	Perc. (%)
Level-1	Knowledge	21	61.76%	Analysis	0	0%	34	100%
	Comprehension	9	26.47%	Synthesis	4	11.77%		
	Application	0		Evaluation	0	0%		
	Knowledge	22	44.89%	Analysis	0	0%	49	100%
Level-8	Comprehension	15	30.61%	Synthesis	1	2.060		
	Application	9	18.36%	Evaluation	2	4.08%		

 TABLE 2

 FREQUENCIES AND PERCENTAGES OF COGNITIVE ORDERS IN LEVELS 1& 8

Table (2) shows that there are 21 items classified as knowledge questions representing 61.76%. There are 9 comprehension questions representing 26.47%, and 4 synthesis questions representing 11.76%. It is clear in the table that there is zero application for analysis and evaluation questions in level 1. It means that LOCS are mostly used in level1test questions. Whereas only four questions in HOCS are used. There are no instances of questions in analysis and evaluation used in level1. This means that both LOCS and HOCS, as thinking skills are concerned, are not adequately reflected. On the other hand, there are 22 knowledge questions representing 44.89%, 15 comprehension questions representing 30.61%, 9 application questions representing 18.36%. This means that LOCS are heavily used in level 1 test questions. It is also noticed that there are only three questions in HOCS. There is no single analysis question used in level 8. This indicates that HOCS are not systematically distributed.

TABLE 3	
INDEPENDENT SAMPLES TEST FOR LEVELS 1 & 8	

Factor	Ν	М	STD	SEM	F	Sig.	DF	Т	Sig.
1	5	0.2000	0.182578	0.8165	4.223	0.074	8	4.445	0.002
2	5	3.1333	1.46439	0.65490					
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M: Mean; N: Number; STD: Standard Deviation; SEM: Standard Error Mean; Sig. at 0.05 level.

Table (3) shows that there is a significant difference between the two levels where F distribution-F (6.064,16) = 0.026<0.05 level. Based on this result, the first hypothesis is proved referring to LOCS and HOCS which are reflected in the exam papers. To confirm the above result, another t-test 1 (t-value t (5.981) and sig value is (0.00) = 0.00 < 0.05 and 0.01)) also proves the same result.

TABLE 4									
INDEPENDENT SAMPLES TEST FOR LEVEL 1									
Factor	Ν	М	STD	SEM	F	Sig.	DF	Т	Sig.
1	5	0.2000	0.182578	0.8165	4.223	0.074	8	4.445	0.002
2	5	3.1333	1.46439	0.65490					

Table (4) indicates that there is no significant difference between the two factors of level 1. As F distribution - F (1.744,6) = 0.235>0.05 level. Based on this result, the first sub-hypothesis referring to the adequate distribution of LOCS in the exams is not proved. However, the result of t-value t (3.806) =and sig value is (0.009) = 0.00 < 0.05 and (0.01) shows that there is significant difference between the two factors of level 1. Therefore, the sub-hypothesis H1a is proved.

TABLE 5									
INDEPENDENT SAMPLES TEST FOR LEVEL 8									
Factor	Ν	М	STD	SEM	F	Sig.	DF	Т	Sig.
1	4	2.5000	1.03638	0.51819	1.744	0.235	6	3.806	0.009
2	4	0.3333	0.47140	0.23570					

Table (5) reveals that there is no significant difference between the two factors of level 8 as F distribution - F (4.223,8) = 0.074 > 0.05 level. Based on this result, the second sub-hypothesis (H1b:) is not proved. However, the result of t-value t (-4.445) = and sig value is (0.002) = 0.00 < 0.05 and 0.01) indicates that there is significant difference between the two factors of level 8. Accordingly, the sub-hypothesis H1b is proved.

VI. DISCUSSION

The results of the study indicate that LOCS in level 1 (88.23%) are used more than HOCS skills (11.77%). This result is similar to what Soleimani (2016), Thanassionu (2003), Zoller (1997) found out. On the other hand, LOCS in level 8 (93.86%) are used more than HOCS (6.14%). This result agrees with the findings reached by Tammy and Long et al., (2010). It is noted that there is adequate distribution and reflection of cognitive skills in level 1 exam questions, whereas; it is not the case in level 8, where the focus was wholly on the LOCS at the cost of the HOCS. What can be drawn out from the findings above is that: exam questions offered in level 1 conform to Bloom's Taxonomy to a high degree, since it lays greater emphasis on the LOCS. This emphasis helps learners to build up their linguistic competence

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at the earlier stages in the learning scaffolding process. However, smooth and balanced transition from one cognitive skill to another in a systematic manner prepares learners for the upcoming levels that demand more mental efforts. As for the exam questions offered in level 8, the emphasis is on the LOCS. This, of course, doesn't conform to Bloom's Taxonomy of Educational Objectives to a high degree. Learners at such level are expected to develop higher cognitive skills such as creative thinking, critical thinking and problem solving which are considered as the goal of outcomes-based education.

VII. CONCLUSION

Teachers and test makers generally tend to pose questions that place more emphasis on knowledge acquisition. Knowledge is considered as the building block of the learning process. Effective training for forming questions that are based on Bloom's Taxonomy enables teachers to gradually help learners to advance from one step to another. By so doing, learners grasp knowledge as well as they promote creative/critical thinking. The findings of the present study emphasize similar conclusion. i.e., LOCS gain greater proportion in comparison HOCS. By contrast, level 8 questions which are supposed to lay greater emphasis on HOCS, focus on LOCS. Although this situation promotes learner's linguistic competence yet, it does not help them to develop HOCS that enables them to solve problems in real life.

VIII. RECOMMENDATION

Based on the findings of the present study, the researchers recommend that teachers have to be familiar with Bloom's Taxonomy of Educational Objectives and practice them in their teaching/testing habits. Careful preparing of test questions using the different cognitive orders assists instructors to provide a wider range of questions that incorporate knowledge retention and recalling as well as requires that learners apply, analyze, synthesize, create, and evaluate information. In other words, test questions should be posted in a scaffolding manner to guarantee systematic cognitive skills development. i.e., LOCS should be given a higher proportion than HOCS in level 1. Similarly, HOCS have to receive greater proportion than LOCS in level 8.

IX. LIMITATIONS AND FUTURE WORK

The present study is wholly devoted to compare exam questions offered at two levels. The comparison of exam papers is made between two levels namely level 1 and level 8 (micro study). However, there are eight levels in the program. Therefore, generalization of the study findings needs to be confirmed with further research (macro study) that covers all levels in the program. So, this study is an attempt to pave the way for comprehensive, studies to be conducted in the area. Consequently, comprehensive, generalizable findings will be generated.

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