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THE EFFECT OF EXPLICIT INSTRUCTION IN CRITICAL THINKING ON HIGHER-ORDER THINKING SKILLS IN READING COMPREHENSION: AN EXPERIMENTAL STUDY

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Abstract:
This study investigates whether the explicit instruction of critical thinking skills can impact students' ability to use higher-order thinking skills in reading comprehension. It particularly focuses on the instruction of critical thinking in its evaluative dimension and measures the impact on the development of three thinking skills, namely *understanding*, *analyzing* and *evaluating*. The EFL preparatory class students in the experimental group (n=27) were trained in using two of these skills for reading comprehension whereas those in the control group (n=29) took their normal classes. The results show that the experimental group significantly improved between the pre- and post-tests and outperformed their control counterparts. These results confirm the hypothesis claiming that high-order thinking skills are teachable. However, the results report that higher-order thinking skills develop independently of lower-order ones.

Keywords: reading comprehension, critical thinking, higher-order thinking

1. Introduction

Reading comprehension is an important skill that can determine the academic success or failure of students, because it is a significant input skill through which students can learn other skills (Koda, 2007). Therefore, the importance of this skill has warranted the

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considerable attention it has received from educational scholars. However, scholars maintain that effective reading comprehension not only involves using such lower-level skills as retention or literal comprehension but goes beyond that to encompass mobilizing a set of higher-level thinking skills such as analyzing and evaluating in order to actively interact with the text (e.g. Bartu ,2001; Beck, 1989; Luke and Freebody, 1999; Pang, 2008). To this end, assigning higher-order thinking questions in the reading comprehension lesson alone might not yield desirable results. Kurfiss (1988) noticed that even though students are often assigned tasks involving higher-order cognitive processes, "*the problem of acquiring the requisite skills is left to the ingenuity, good fortune, and native ability of the student*" (p. 22). This raises questions about how higher-level reading comprehension can be improved in EFL learners. One subject of focus that might have potential help to train students to perform higher-order thinking in reading comprehension is explicit instruction in critical thinking skills. This paper aims to investigate whether explicit instruction in critical thinking skills can have an impact on Moroccan EFL students' ability to improve their higher-level reading comprehension skills.

2. Literature Review

2.1 Higher-order thinking

The concept of higher-order thinking, as contrasted with lower-order thinking, has been approached in different ways by different theoreticians of the field. In a broader sense, Maier distinguished between behaviors that entail reflection, creativity and innovation, which he described as "*reasoning or productive behavior*", and behaviors that involve only rote learning and recall, which he designated as "*learned or reproductive behavior*" (as cited in Lewis & Smith, 1993, p. 132). By defining higher-order thinking as such, Maier established a link between higher-order thinking and meaningful learning on the one hand, and related lower-order thinking to rote-learning on the other hand. Overall, the implication of Maier's definition of higher-order thinking skills is that the concept in its broader sense encompasses critical thinking, problem solving and creative thinking.

According to Anderson et al. (2001), constructivist learning, or meaningful learning, goes beyond introducing factual knowledge to learners, and its assessment involves more than merely recalling or recognizing previously learned input. Rather, meaningful learning involves learners in active cognitive processing that trains them to transfer their learnings into contexts other than the classroom.

In its narrower sense, higher-order thinking has been operationalized differently by different taxonomies. In Bloom's Revised Taxonomy (Anderson, et al., 2001), which was used as the conceptual framework of this study, higher-order thinking refers to the three upper cognitive categories; namely **analyzing**, **evaluating** and **creating**, the three lower ones being **remembering**, **understanding** and **applying**.

The components of Bloom's Revised Taxonomy are referred to as cognitive categories, each one of which includes within its scope a set of cognitive processes.

Thus, according to this approach, **analyzing** refers to "*breaking material into its constituent parts and determine how the parts relate to one another and to an overall structure*" (p. 79). The cognitive processes that are included in the category of analyzing are **differentiating**, **organizing** and **attributing**. **Differentiating** is defined as "*distinguishing between relevant from irrelevant parts or important from unimportant parts of presented material*" (p. 80). **Organizing** refers to "*determining how elements fit or function within a structure*" (p. 81). And **attributing** refers to "*determining a point of view, bias, values or intent underlying presented material"* (p. 82).

Anderson at al. (2001) define **evaluating** as "*making judgments based on criteria and standards*" (p.83). The category of *evaluating* encompasses two cognitive processes, *checking* and *critiquing*. **Checking** refers to "*detecting inconsistencies or fallacies within a process or product; determining whether a process or product has internal consistency; detecting the effectiveness of a procedure as it is being implemented*" (p. 83). **Critiquing** means "*detecting inconsistencies between a product and external criteria, determining whether a product has external consistency; detecting the appropriateness of a procedure for a given problem*" (p. 84).

Creating in Bloom's Revised Taxonomy refers to "*putting elements together to form a coherent or functional whole, reorganize elements into a new pattern or structure*" (Anderson, et al., 2001, p. 68). This category involves three cognitive processes; **hypothesizing**, **designing** and **constructing**.

Hypothesizing is defined as "*coming up with alternative hypotheses based on criteria"* (p. 68). **Designing** means "*devising a procedure for accomplishing some task*" (p. 68). And *constructing* refers to "inventing a product" (p. 68). In this research, the higher-order thinking questions include only *analyzing* and *evaluating*, whereas *creating* is excluded because of the difficulties of evaluating it using multiple-choice comprehension questions.

However, the definition of critical thinking is characterized with little consistency but considerable overlapping. Cuban (1984) noticed that defining critical thinking is "*troublesome to both social scientists and practitioners. Troublesome is a polite word; the area is a conceptual swamp*" (p. 676). The discrepancies in approaches to the concept may be due to the fact that the theoreticians who have developed it come from different backgrounds. Lai (2011) stated that research in critical thinking was developed by philosophers, psychologists and educational practitioners. Its nature has also been a subject of controversy. An example is its relationship with problem solving. A trend defines critical thinking as a set of skills that involves both evaluation and problem solving. Ennis (1987) defines critical thinking as "*reasonable, reflective thinking that is focused on deciding what to believe or do"* (p. 10). A different trend, however, separates them. Beyer (1985) believes that critical thinking "*is not problem solving. It is not a cover-all term for all thinking skills*" (p. 276). A further issue about critical thinking is whether it is convergent or divergent. Ennis (1987) inserts creative thinking in his definition of critical thinking whereas Quellmalz restricts critical thinking in an evaluative aspect by defining it as "*clarifying issues and terms, identifying components of arguments, judging the*

credibility of evidence, using inductive and deductive reasoning, handling argument fallacies, and making value judgments" (as cited in Lewis & Smith, 1993, p. 134).

Thus, the implication is that critical thinking in its larger sense, as in the definition of Ennis (1987), can be used interchangeably with higher-order thinking. Both concepts in this case encompass convergent and divergent thinking; i. e. analytical, evaluative and creative thinking at the same time. However, in its narrower sense, critical thinking is just a part of higher-order thinking, because in this case critical thinking is confined to an analytical and evaluative aspect.

Critical thinking is approached in this study in its narrower sense. The explicit instruction targeted informal logic which is the study of arguments, their definitions, components, types and how they can be evaluated. As such, the relationship between critical thinking and higher-order thinking is one of a part and a whole.

2. Reading comprehension and higher-order thinking

An array of research studies investigated the effects of different types of interventions on students' reading comprehension skills (Kolić-Vehovec & Bajšanski, 2006; Reddin, 1968; Remark & Ewing, 2015; Yousefi & Mohammadi, 2016). The existing literature has provided insights not only into the effective classroom practices to adopt so as to improve students' ability to use thinking skills in reading comprehension but also into how to avoid less effective practices that may hinder reaching this objective.

Reddin (1968) examined the effect of instruction in listening on learners' reading and critical thinking skills in a sample of learners from the fourth, the fifth and the sixth grades. The instruction on listening given to the treatment group consisted of a variety of eighteen lessons that included listening games, oral arithmetic activities and other materials read to the learners from scientific, social studies or reading books. Reddin found that the intervention was not effective to reading for the fourth and fifth-grade pupils but was so for the sixth graders. Unlike reading, the intervention was not effective to improve the learner's critical thinking ability. These findings imply that there is a significant relationship between the ability to transfer learned skills and strategies and age. Sixth-grade pupils' reading skills improved through instruction in listening but those of fourth and fifth grade pupils did not. Another implication is that gains in critical thinking cannot take place with instruction in other fields. These findings confirm Halpern's (2014) contention that "*critical thinking instruction needs to focus overtly and self-consciously on the improvement of thinking, and the learning experience needs to include multiple examples across domains in order to maximize transfer*" (p. 17).

Similarly, Remark and Ewing (2015) carried out an action research project to investigate the effect of the use of higher-order thinking questions during guided reading instruction on students' reading comprehension skills and engagement. The researchers administered a pre-test before introducing eight participants to six-week guided reading course. The post-test results showed that the use of higher-order thinking question in guided reading is effective to increase learners' comprehension,

engagement and metacognition. However, the study needs a more solid theoretical framework. The researchers adopted two theoretical frameworks, Bloom's taxonomy (1956) and Anderson et al's (2001) revision of Bloom's taxonomy without adequate justification for this blending.

Kolić-Vehovec and Bajšanski (2006) explored the effects of metacognitive strategies, namely comprehension monitoring and perceived use of reading strategies, on effective reading comprehension. This correlational study confirmed that comprehension monitoring and perceived use of reading strategies are significantly and consistently related to reading comprehension only at higher levels of elementary school. The two researchers concluded that the elementary school might be the right moment to introduce students to reading skills that go beyond literal comprehension of scripts. The students' ability to demonstrate metacognitive awareness might be an indicator of their ability to interact with reading comprehension tasks more critically. This implication overlaps with that of the aforementioned study about the relationship between the factor of age and the ability of skill transfer.

In the same vein, Aloqaili (2012) reviewed analyzed correlational studies exploring the relationship between critical thinking and reading comprehension. He observed that the literature revealed an agreement between theorists and researchers that there is a well-established relationship between critical thinking and reading comprehension. Yousefi and Mohammadi (2016) confirmed Aloqail's (2012) findings in the study they conducted to explore the relationship between critical thinking and reading comprehension among Iranian postgraduates. Their study showed a significant relationship between critical thinking and effective reading comprehension.

However, the issue with the findings of these studies- (Aloqaili, 2012; Kolić-Vehovec & Bajšanski, 2006; Yousefi & Mohammadi, 2016) - is that correlation does not entail causation. The present study looks into this relationship from an experimental perspective in which causality emanates from the treatment the students have received. It also investigates the effect of teaching thinking skills on reading comprehension in EFL students who may not have had prior training in this same area.

2. Method

This paper aims to investigate the effect of explicit instruction of critical thinking on Moroccan EFL students' ability to demonstrate higher-order thinking skills in reading comprehension. To meet this objective, the study uses an experimental design and tries to answer the following research question:

What is the effect of explicit instruction of critical thinking skills on Moroccan EFL students' ability to use such skills in reading comprehension?

2.1 Participants

The participants of this study were two classes of the first year of Les Classes Préparatoires Aux Grandes Ecoles (preparatory classes henceforth), math option. The

two groups belonged to two different schools in Casablanca. The experimental group initially consisted of 31 students. Four of them were excluded because they did not take both of the pre- and post-test; one missed the pre-test and three missed the post-test. Hence, the experimental group consisted of 27 students (M=17, F=10). The control group consisted of 30 participants. One of them was excluded because he missed the post-test. The study kept the records of 29 students (M=19, F=10).

2.2 Instrumentation

The instruments used in this study included a reading comprehension pre- and post-test and a training kit. A similar test was administered to the participants as both pre- and post-test. The rationale behind this choice is to neutralize the variable of the difficulty. The participants were not given the correction of the text. It was assumed that the period between the pre- and the post-test might be sufficient to forget the answers.

The reading comprehension test included a 1047-word long test, and 12 multiple-choice Items. Each item comprised a stem and four distractors among which only one is correct. The multiple-choice items were designed to assess three cognitive categories, **understanding**, **analyzing** and **evaluating**. Three items assessed **understanding**; two the cognitive process of **inferring** and one **summarizing**. Four items targeted the cognitive category of **analyzing**, including one item assessing the cognitive process of **organizing**, and three the cognitive process of **attributing**. The five remaining items were devised to assess the **evaluating** cognitive category. Three of them assessed the cognitive process of **checking**, whereas two the cognitive process of **critiquing**.

Three raters were recruited to assign each of the fifteen questions to the cognitive skill it aims to assess. Cronbach's alpha came to 0.906, which indicates a high level of consistency for the instrument.

2.3 Procedure

Before the intervention, the participants took the pre-test. They did not receive any feedback on the test. The topic of the article was not tackled in the intervention in order to avoid testing the participants for recall in the post-test. The experimental group benefited from a training in argumentation. The intervention lasted three sessions of two hours each. The objective of the first session was to explain what an argument is, its types and how to analyze it. To do so, the students were assigned a short argumentative text. The second session invited the participants to distinguish between deductive and inductive arguments, and how to evaluate the validity and soundness of the former type, and how to check the strength and cogency of the latter. The scaffolding stage was followed by further practice through another short text. The third session was devoted to study how to evaluate the validity and soundness of deductive arguments and the strength and cogency of inductive ones. This is followed by a practice stage consisting of evaluating arguments used to defend a thesis in a reading comprehension text. In the meantime, the control group continued their ordinary English course. It mainly focused

on reading comprehension, translation from English to French and vice versa, speaking and writing. After the intervention, the post-test was administered to both groups.

2.4 Data analysis

The collected data from pre- and post-tests were analyzed on the SPSS (Statistical Package for Social Sciences) program. The descriptive and inferential statistics are used to compare the two groups marks on the different thinking skills to check whether the difference between the groups is significant.

3. Results

The descriptive statistics of the two groups show some improvements from pre-test to the post-test performance. The students in the experimental group outperform their peers in the control group as the following table shows:

Table 1: Descriptive statistics of the performance by the two groups

		Mean	**SD**
Control group	Pre-test	7.36	1.94
	Post-test	7.95	2.66
	End-term exam	12.19	1.75
Experimental group	Pre-test	8.94	2.33
	Post-test	10.86	2.02
	End-term exam	11.41	0.97

A deeper look into the performance by the two groups reveal further results. The one-way ANOVA between the subjects reveals that the two groups showed a significant difference in both analyzing [F(3,108)=5.71, p=0.001] and evaluating [F(3,108)=6,56, p=0,000] but there is no significant difference in understanding [F(3,108)=1,87, p=0,140]. These statistically significant results in two cognitive categories, namely analyzing and evaluating, are further scrutinized using a paired t-test to compare the experimental and the control groups' results.

Table 2: Pre- and post-test comparisons of the control and experimental groups

		Pre-test		**Post test**			
	Category	**Mean**	**SD**	**Mean**	**SD**	**t-test**	**p.**
Control group	Understanding	3.86	1.85	4.06	2.03	0.46	.65
	Analyzing	3.93	1.89	4.34	2.33	1.18	.25
	Evaluating	3.84	1.96	3.52	2.05	0.75	.46
Experimental group	Understanding	4.44	1.60	4.89	1.40	-1.36	.18
	Analyzing	4.96	1.60	5.92	1.71	-3.12	.004
	Evaluating	0.96	1.60	1.48	2.81	-2.74	.01

The differences in the control group are not significant. Therefore, the students did not progress in any of the three cognitive categories. Whereas, the figures show that the

experimental group progressed substantially in analyzing and evaluating, but not in understanding.

The correlation coefficients between the participants' scores in the pre-test, the post-test and their end-of-term English exam yield interesting results. The correlation between pre-test and the end-of-term exam shows no significant correlation (r= -.005; p=0.980). The correlation between their post-test and end-of-term exam scores shows the same results (r=.23; p=0.216). However, their pre-test scores correlate significantly with their post-test ones (r=.58; p=0.001). Like the control group, the experimental group's scores in the pre-test and end-of-term exam do not correlate significantly (r=.27; p=0.161). Nonetheless, both their scores in the pre-test and post-test and their ones in the post-test and in the end-of-term exam do correlate significantly, respectively, (r=.45; p=0.018) and (r=.43; p=0.026).

4. Discussion

The control group benefited from the same amount of training and exposure to language as the experimental group. However, their training consisted of practice of reading comprehension, translation from English to French and vice versa, writing and speaking. Their scores demonstrated that they did not achieve any significant progress neither in lower-order thinking (understanding) nor in higher-order thinking (analyzing and evaluating). These findings imply that cognitive skills do not develop as by-product of other language skills. The students in the preparatory classes undergo training that might help them develop skills such as commentary writing, translation, speaking skills or other language skills. However, their critical thinking skills remain less developed unless they are explicitly and purposefully addressed. This finding confirms the hypothesis claiming that explicit instruction has effect on the students' learning of thinking skills. This finding corroborates Reddin's (1968) who found that critical thinking skills could not be improved by training six-grade pupils in listening skills. Similarly, it reinforces Halpern's (2014) findings claiming that learners can achieve good gains in critical thinking only when they are deliberately taught to think critically. However, they are not likely to become critical thinkers by simply "*getting a good education*" (Halpern, 2014, p. 17). This implication is further supported by Iwai's study (2016) which reinforces that explicit instruction on strategic reading is an effective method to increase students' awareness of metacognitive reading strategies.

However, explicit instruction in critical thinking skills did not help the participants to improve their scores in understanding. This reveals that training in higher-order thinking skills may not automatically enhance students' lower-order thinking skills. As such, in order to improve a given cognitive skill, be it lower- or higher-order, it must be taught purposefully and explicitly. This suggests that processes underlying these cognitive skills may operate in parallel and that training should cover all of them. It also suggests that little transfer takes place from a skill to another. By the same token, this suggests that the lower- and the higher-order thinking skills are not

hierarchical. Lower-order thinking skills may not be a prerequisite to higher-order thinking skills. The participants who were trained to analyze arguments, to identify their premises and conclusions, to classify them into deductive vs. inductive ones and to evaluate their soundness or cogency accordingly, were capable of using these critical thinking skills to address higher-order thinking questions in reading comprehension. However, most of them were not capable of using contextual clues to infer meaning from context for example, or to effectively deal with other lower-order thinking questions because they were not trained to do so. Practically, since achieving considerable gains in higher-order thinking skills does not necessarily require high performance in lower-order thinking skills, it may be well suggested that higher-order thinking should be introduced to students even with low academic profiles. This suggestion supports Zohar and Dori's (2003) recommendation that teachers should engage students of all academic levels in tasks that involve higher-order thinking skills. Fand (1989) also thinks that engaging low-proficiency students in such tasks can motivate them.

The relationship between the participants' performance in the final exam and their critical reading skills results in drawing conclusion that training at the preparatory classes tends to neglect nurturing critical thinking skills and higher-level reading. The trainers' preoccupation with exam-oriented training drives them to give more importance to needed skills such as translation between English and French, textual comprehension and writing skills at the expense of higher-level skills.

4.1 Limitations

According to Halpern (2014), "*the whole enterprise of learning how to improve thinking is of little value if these skills are only used in the classroom or only on problems that are very similar to those presented in class*" (p. 17). Her point is that training in thinking skills remains pointless unless the outcomes of this training are transferred to contexts other than those where they were taught in the first place. However, constraints related to the participants' availability came in the way of investigating whether they could transfer their gains in critical thinking to skills other than reading comprehension, or to subjects other than English. Future research could explore this avenue.

5. Conclusion

The findings of the current study reveal that explicit instruction of critical thinking skills has effect on students' use of higher-order thinking skills in reading comprehension. However, this instruction cannot be useful to improve students' lower-order thinking skills in reading comprehension. These should be addressed in another type of instruction that targets them in a focused way.

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Authors' contributions
ER designed the study, prepared the instruments, and conducted the intervention with the experimental group. AB participated in designing the study and preparing the instruments, performed the statistical analysis, and drafted the manuscript. AZ participated in designing the study, selecting the instrument and drafting the manuscript.

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