Impact of Computer Concept-Mapping Instruction on Iranian EFL Learners' Writing Performance: Complexity and accuracy in focus

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Abstract
This inquiry investigates the impact of Computer Concept-Mapping on Iranian EFL learners' writing complexity and accuracy. To this end, a total of 30 intermediate EFL learners aged 14 to 16 years were non-randomly selected, homogenized in terms of general proficiency, and classified into two treatment and control groups. Also, a pretest and a posttest on the participants' writing performance were administered at the beginning and the end of the study.. Further, the ESL Composition Profile developed by Jacobs et al. (1981) was used as a criterion for evaluating the participants' writing accuracy and complexity. The treatment group received computer-based concept mapping instruction, while the control group was instructed through conventional writing techniques. Then, the data obtained from the two groups' pre- and posttests were comparatively analyzed through appropriate statistical tools. Parametric paired-samples and independent-samples *t*-tests as well as Pearson Correlation were also used to assess the inter-rater reliability indices of the participants' writing tests. The results of data analysis indicated that computer concept-mapping instruction entails significantly better writing performance. This finding has implications for teachers and EFL programmers to use the latest methods and tools of instruction.

Keywords: Accuracy, complexity, computer-based instruction, concept-mapping, writing skill

Introduction

Writing can be utilized through learning and encouraging others (Graham, Gillespie, & McKeown, 2013). It includes high-level processing where thoughts and emotions are conveyed, organized, revised, and evaluated (Gözüküçük, 2016). Nowadays, writing is a vital communication channel that is used in daily interactions around the globe. It is a vital skill that the learners must fully complete over communicative competence. Within learning and teaching, writing has a leading role by which the learners can be evaluated. According to Plakan (2008), writing is a multifaceted procedure requiring learners' ability to successfully organize language parts logically. Hence, for this skill, the learners should be more capable of making the most productive communication process.

Defranco-Tommarello, Yablokow, Bilen, & Gordon (2012) assert that while engaging in writing, it is worthy calling its general elements. Basic ideas related to writing include genre, style, structure correctness, vocabulary aspects, and spelling. Based on Rahman and Ambreen (2018), among other skills, writing is regarded as the most significant one from a pedagogical

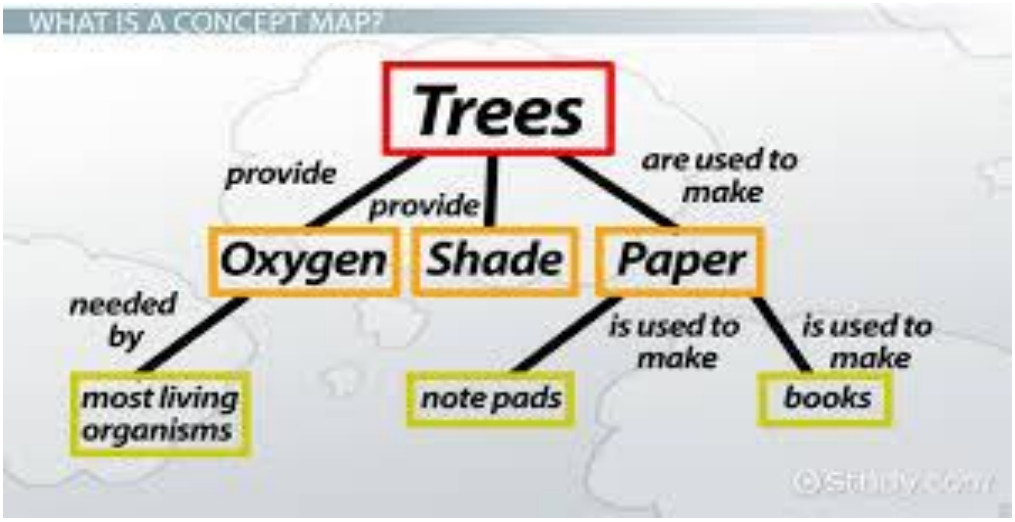
perspective. Kellogg (2008) indicates that the writing procedure involves factors such as language production, planning, and reviewing, and taking notes.

Listening and reading are also dependent upon writing (Saed and Al-Omari, 2014). Factors such as shortening, analysis, and critical views are also stimulated by writing tasks by focusing on the constant reflection in goal language (Maghsoudi and Harrison, 2013).

Planning time attracted a considerable deal of attention in numerous investigations in producing L1 and L2 (Wigglesworth, 2009). These studies are mainly rooted in L1 research aimed to develop the mental models for oral construction as one of their factors. Based on Novak (2010), Computer Concept-Mapping is an approach for probing learners' comprehension of associations among the concepts. In reality, a computer concept map is a visual organizer that can enrich learners' understanding of a new concept. Using a graphic organizer, students think about the concept in several ways such as sub-branches. See an example of computer concept map in Figure 1 below:

Figure 1

An example of a concept map



In Tajeddin and Tabatabaei's (2016) words, computer-based mapping can be utilized as a mental instrument in supporting learners to set up the learnings, and to improve self-awareness via thinking reflectively. Asoksoy (2019) believes that computer concept-mapping is an important tool that is used in the field of education to help students in understanding the basic concepts and the relationships between them. He adds that it is significant in the sense that in a rapidly changing world of second language learning, it is essential to educate students who think accurately, visually, critically and analytically. In fact, there is a common denominator between visuals and thought and between mind and the pictures since they interact with each other to provide an opportunity for humans to make correct decisions and to have rational thoughts.

Based on the above-mentioned points, this study was an attempt to assess the impact of computerized concept-mapping learning strategy on the complexity and accuracy in Iranian intermediate EFL learners writing. As such, the following research question was addressed:

RQ: Does computer-based concept mapping have any significant effect on the complexity and accuracy of Iranian intermediate EFL Learners' writing?

Literature Review

Writing is a complicated and mental process in which several social and cognitive factors are engaged (MacArthur & Graham, 2016). It is vital to academic achievements since it is the most ordinary assessment measure for academics to evaluate their students, and students' weak writing ability may put their academic success considerably in danger. (Tan, 2011). According to Javadi Safa (2018), the mastery of writing and its leading position in showing learners' learning degree is undeniable in second language teaching and research. Writing is viewed, he believes, as a challenging task, even for native speakers though it is much more threatening for non-natives, especially EFL learners. In 2001, Chenoweth and Hayes conducted research on 13 learners utilizing the concept maps. By measuring the complexity and accuracy as the number of words written for each minute, they realized that learners with more experience in the language possessed a higher fluency, accuracy and complexity score than those without it. A research carried out by Ahangari and Behzady (2011) dealt with computer-mediated concept mapping on the writing skill of EFL Iranian learners. The elements of writing studied were: content, words, sequence, systems, and language application. The outcomes showed a highlighted impact of concept mapping on writing skills in general. Another investigation on Iranian university students was conducted by Fahim and Rahimi (2011) to see the effects of concept mapping on writing skills. The obtained findings manifested that learners in the treatment group performed better than those of the control group. In an experiment conducted by Feizollahi and Zarei (2018), the effect of computer concept mapping was assessed on writing in grammatical accuracy and writing anxiety. Here, the concept mapping group obtained the highest mean followed by the brainstorming group. In one more research carried out by Jafari and Zarei (2015) the effect of concept mapping strategy on Iranian EFL learners' argumentative essays was investigated. This study was done with 60 adult EFL learners from a language institute in Isfahan, Iran. Based on the obtained findings, it was found that concept mapping strategy instruction was very influential in enhancing learners' argumentative essay writing.

According to Plotnick (2018), concept mapping can be easily in access, and the potential benefits increase with computer employment. He states that there are many benefits of computer-based concept mapping as compared to paper-based maps, such as the capability of automatically add concept boxes, correct erroneous placements without redrawing, recording sounds, add video, and connection concept maps. Alosaimi (2016) believes that the map is thorough since it begins in a central question that starts a root proposition. The map is then formed by engaging in the knowledge base of learners, adding new plans and connecting them to previously-created ones, and explaining the retrieved knowledge within a network like a mode. Wang, Wu, Kirschner, and Specto (2018) state that concept mapping is the most commonly employed strategy in instructing concepts and acknowledging and removing the misconceptions of education. Finally, in an treatment research carried out by Nobahar, Nemat Tabrizi and Shaghaghi (2013) on the impact of computer concept-mapping on writing, trainees in the treatment group treated by concept map construction after writing each task, organized their pre-writing activities such as doing exercises, and reflective practices based on constructed maps. A posttest of writing and an efficacy questionnaire administered to all the participants, and the pair sample *t*-test, and independent sample *t*-test were used to answer the study questions. The obtained results indicated that concept mapping had a significant effect on self-efficacy and expository writing accuracy.

Method

Participants

To select representative participants for the purposes of the study, two naturally intact female classes of an institute in Ilam, Iran, were considered. They compromised 60 female EFL learners within the age range of 14 to 16 years old, who were pursuing their English studies for approximately six semesters of 16 sessions, each lasting 60 minutes. Through a standard test, half of them (No.30) whose scores fell one standard deviation below and above the mean was selected as intermediate learners. They were then assigned to treatment and control groups of equal size. The selection of the participants for this quasi-treatment study was based on the institute's agreement to cooperate.

Instruments

The tools to meet the required objectives of the study were: Oxford Quick Placement Test (OQPT), writing proficiency pretest and posttests, and ESL Composition Profile developed by Jacobs et al. (1981), which was used as a criterion for evaluating the participants writing accuracy and complexity.

Procedures

To accomplish the objectives of the study, the following procedures were followed:
Using OQPT, the participants were selected in terms of their general English proficiency performance as intermediate level learners, who were then divided into two treatment and control groups. Then, both groups took a pretest in writing without concept mapping. The test included reading, writing, and vocabulary. As the study focused on the writing ability of the learners, the speaking section was not administered. The test contained 50 items. For the assessment, the researchers used the PET general mark scheme, which is used as a rubric for a summative score. The criteria included language range, variety, complexity, message communication, grammatical structure, vocabulary, spelling, punctuation, content points, length, and target reader. Both the CG and EG took the same pretest. The test included two sections. The first section required the students to read a passage (a 10-line text about different aspects of *A Perfect Universe),* since the focus was on writing. Then, they were asked to write an essay related to the passage according to the instructions provided. The essay was supposed to be between 250 to 300 words. The remaining part of the pretest included a topic given to the participants to write an essay of 300 words about. Only one topic was given to them, not several topics to choose from, because if the writings were of different topics, scoring, rating, and evaluating of so many writings and comparing them would be less accurate. The topic given in this part was: What is the first thing people notice about you, and why do you think it is? The participants were requested to prepare their written texts in 60 minutes.

Passing this stage, the two groups were exposed to instruction, which took them eight weeks (16 sessions, two sessions per week). The treatment group received writing instruction through computer concept-mapping strategy which included explanations and practices on writing with various topics and numerous tasks. In contrast, the control group was taught through conventional techniques of teaching writing, which encompassed similar tasks as the treatment group. According to Harini, Nilakusmawati, and Astawa (2017), a concept map is a visual thinking instrument that applies to all mental functions, mainly to memory, learning, creativity. The analysis of concept mapping is a structured process, concentrated on a topic of interest, including input from one or more participants, that produces an interpretable pictorial view of their ideas and concepts and how these are interrelated. Thus, the participants in this study went ahead step by step in writing a text; from short paragraphs to long essays of five precise

paragraphs. They practiced to write about simple topics and tried tasks like writing six to eight sentences about a topic and then connected them to make a coherent text.

Based on concept-mapping instruction, when the participants have the topic and come across a persistent problem, the next step is to recognize the most inclusive, critical concepts applied to the topic domain. The more concepts they can provide, the better they can construct their map and their writing. Usually, 15 to 25 concepts are sound. They have to list the concepts in a hierarchical manner. This task helps them to start the map construction process. They actually move the concepts in the list into the concept map. In the present study, as a first step, the teacher asked the learners to write down twenty words or phrases related to making paper out of wood, in the order of concepts and steps that occur from a field or a jungle to the paper factory. Then, they were required to determine the connections or cross-links among them. In the next stage, the learners were asked to prepare the appropriate concept-map. In fact, the teacher requested them to connect the concepts to appropriate cross-links. Based on the provided concept map, they were then required to develop their writings, that is, to write a sentence for each step, consisting of two concepts related to each other by a link. Finally, they developed their writing through revising forming the sentences into a well-written text. To revise the text, they had to add adverbs, connecting words, punctuation marks, etc. to make their writing acceptable. The treatment group participants practiced these steps every session and tried to enhance their writing skill.

Measurement

Complexity and accuracy have been considered in many studies as the critical criteria to show the exactness and the complicatedness of learners' written and oral production. Hence, the collected data in the present study were coded for accuracy and complexity constructs, and since the contributors were intermediate, the coding was shortened. Therefore, for complexity which is divided into the quantity of embedding, length, and frequency of definitely sophisticated structures, only the length of the T-unit, exclusive of the qualitative aspects, was taken into account. For accuracy, error-free T-units per total number of T-units' ratios were calculated. Generally, coding the data was performed as follows:

- Complexity: Mean length of T-units
- Accuracy: Error free T-units per overall T-units' ratio

The written texts of the participants were delivered to two coders-- the author as the first coder, and a specialist instructor with six years of teaching experience as the second coder. They coded ten same texts and came up with inter-rater reliability of 0.92. Then, they discussed the inconsistencies and obtained an agreement of 100%. Ultimately, the quantitative data were drawn in Microsoft Excel charts and converted into line graphs for visualization of the dynamic and complex development of the participants' writings.

Results and Discussion

The purpose of this study was to examine the impact of using computer concept-mapping instruction on Iranian EFL learners' writing accuracy and complexity performance. The obtained results revealed that computer concept-maps have a positive significant effect on the participants' accuracy and complexity writing achievement. The results are tabulated and discussed below.

As for the pretest mentioned above, the obtained scores from both parts of the pretest were added up and the final score of each participant was determined. Table 1 portrays the results.

Table 1
Pretest Final Results

Pretest Total		Results Treatment Group	Results Control Group
Participants Number		15	15
Test Total score		100	100
Mean	Mean	33	31
	Std. Deviation	4.25	5.47
Most Extreme Differences	Positive	94	90
	Negative	44	46

Concerning the posttest, Table 2 beloe shows the results.

Table 2
Topic-Based Writing Post-Test results

Topic-Based Writing Test		Results TG	Results CG
Participants Number		15	15
Test Total score		50	50
Mean	Mean	43	35
	Std. Deviation	3.35	6.89
Most Extreme Differences	Positive	48	45
	Negative	27	24

A comparison between the pre- and posttests results shows that there have been significant changes in the treatment group performance. In fact, compared to the pretest results, the obtained statistical results of posttest reveal that there were differences between the control and the treatment groups, proving that computer concept-mapping has been effective. As Tables 1 and 2 show, the mean score for treatment group was 33 in the pretest and is 43 in the posttest, s a 10-score increase in the mean score; whereas the mean for control group was 31 in the pretest and was 35 in the post-test, which shows a small 4-score increase. Thus, the computer concept-mapping group showed significant improvement in the topic-based writing test.

Based on this finding which is in line with many other findings of previously-conducted studies stated above in the Review section, we can claim that in designing EFL books related to English education in Iran, technology-based instruction trends and their impact on learning should be seriously taken into consideration. This finding actually reveals the potential importance of using the latest and one of the best tech-based methods of language instruction to develop EFL learners' writing skill. By the same token, educational programmers and instructors must be more carefully perceptive about this method, since ignoring the latest techniques and technologies in education can have unwelcome outcomes. Teenage learners too, with their unique interest and enthusiasm about new techs will definitely enjoy new methods and tech-based classes such as a writing class with computer concept-mapping. They look at everything with special care and alert (Obikwelu, 2017). In fact, young learners are much alert and sensitive towards any new thing, subject, method, or lesson. This feature of young learners should come into use within the educational environments.

All in all, analysis of data in this study indicates that application of tech and planning activities is influential in developing the language learning process in terms of writing skill improvement of Iranian intermediate EFL learners. Actually, the application of computer concept-mapping to boost writing skill is a process of activating the learners' previous personal knowledge and introducing its content to them. The concept map for a learner to prepare his/her writing plan is made after constructing and brainstorming a categorization map. Then, this map is made and prolonged by additional information obtained from additional self-knowledge elicitation and reading the textual sources and can provide the writing plan so that learners can produce lengthy writings with unlimited words.

Conclusions

The building block of this study was a basic thought to inspect the effects of concept-mapping learning strategy, as the independent variable, on the treatment group EFL learners' writing performance in terms of accuracy and complexity. As mentioned earlier, given the tremendous global expansion of information communication technology, the use of computers in education has become indispensable. Therefore this inquiry was actually developed on the basis of the application of computer concept-mapping, as concept maps is believed to help visualizing the main thoughts and summarizing the concepts and their relations. The results of the study revealed that there a meaningful relationship exists between EFL learners' writing performance regarding complexity and accuracy and concept-mapping strategy use. Overall, based on this finding, it can be concluded that employing concept-mapping strategy in teaching English writing is significantly helpful to enhance learners' writing achievement.

The finding of the study has some pedagogical implications as follows:

First, in order to improve language learning and learning achievements in general, and essay writing in particular, it is highly recommended that teachers use appropriate techniques to improve and awaken their students' creativity in using educational technology. It is worth noting that various techniques based on technological theories can be influential in providing enough motivation and get the best benefit in achieving language knowledge for intermediate EFL learners.

Second, teaching and teacher-training programmers can make use of this finding to create necessary shifts in materials, equipment, and coursebooks, with the intention to focus on the best methods of education.

Third, it is presumed that this study can be reiterated in all aspects of language teaching, from vocabulary and grammar to listening and reading skills, to check the possible utility of concept-mapping instruction.

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