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Research Article

Individual and Collaborative Computerized Mind Mapping as a Pre-Writing Strategy: Effects on EFL Students' Writing

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Abstract

This study examined the effects of computerized mind mapping on EFL students' essays in terms of content, organization, language use, vocabulary, and mechanics. The theoretical framework was based on writing-as-process approach. Explanatory sequential mixed methods design was used to collect data. Quasi-experimental research data was collected from 45 students who were assigned to two treatment groups as individual and collaborative computerized mind mapping and control group. All participants completed a survey before and after the treatment. The experimental groups were trained on the use the mapping tool. The essays were scored according to Jacobs et al.'s (1981) rubric. The quasi-experimental phase was followed by semi-structured interviews. The results suggested the individual-mapping group performed better than the control group in terms of content and organization in all essay tasks while the collaborative-mappers outperformed control group in the second task. The results of semi-structured interviews revealed that learners had positive experiences in using computerized mind mapping as a pre-writing activity in EFL context and their attitudes towards writing were quite positive.

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Introduction

There is no doubt that writing is a demanding task for EFL students. Writing is not a practice of set of rules and teaching L2 writing is not simply providing opportunities to write. Writing-as-a-process approach places a great deal of emphasis on multiple drafting with planning and revision, explores critical issues such as voice and audience, highlights the recursive nature of writing, and supports peer or teacher feedback (Grabe & Kaplan, 1996). However, for many reasons, such as time constraints and the high number of students in classes, some stages of the process writing cannot be fulfilled properly or skipped completely during instruction. Language instructors may make use of computers and extend learning beyond the walls using computer-based L2 practices. Therefore, the present study

addresses the completion of pre-writing stage in a digital learning environment by using computer-based mapping activities. Altough compterized mind mapping is acknowledged as an effective technological tool for knowledge representation (Anderson-Inman & Zeitz, 1993), very few studies have been conducted on them until recently. This study aims to provide information about the effectiveness of computerized mind mapping on the pre-writing activities of learners in an EFL context.

Writing-as-process approach

Although it is not arguable whether writing should be taught, there are distinctive but complementary perspectives on how to teach writing. This study is embedded in the theoretical framework based on teaching writing-as-a-process approach. This approach contrasts with the product-based writing approach in which the ultimate goal is to produce a model text and focuses on the many cognitive stages of producing a written text. Writing-as-process approach prioritizes the development of learners' metacognitive awareness of the process (Hyland, 2003). It requires time and positive feedback from the instructor and peers to be done well.

Flower and Hayes' (1981) cognitive model of writing is composed of three major elements: task environment, writer's long-term memory (writer's knowledge), and the writing process. The writing process includes planning (the internal representations of the knowledge), translating (the visible language) and reviewing; all of which are under constant inspection of the monitor. Flower and Hayes (1981) depict the significance of planning in relation to limited attentional resources that are on display during translation. They consider that the demands of the translation stage could be so high that this extra burden on children and inexperienced writers might exceed the capacity of short term memory. To illustrate, if writers focus more on language problems (spelling, grammar etc.), they might strive for what they want to say; however, if they focus on what they want to say and ignore language, they may have many linguistic errors. In both cases, it is expected to result in some kind of frustration from the writer's perspective and planning, either pre-task or within task, could help to minimize the cognitive burden of the writer and reduce the writer's frustration.

Pre-task planning

Sokolik (2003) defined writing as "the learning of a series of skills leading to that product" (p. 96) rather than a final output and these skills are brainstorming, mapping,

drafting, giving feedback, revising, proofreading, editing. It is, therefore, one of the duties of a writing teacher to help students comprehend the process of writing through the invention, drafting, revision, and evaluation. Flower and Hayes (1981) considered planning as an important part of the writing process because it helps the writers set goals, brainstorm, organize the ideas, and decide on the text structure. Planning contains sub-processes such as generating ideas, organizing and goal setting. According to Flower and Hayes (1980) defining the rhetorical problem and setting goals in line with the creativity generate the major difference between good and poor writers. Following this model, a large body of research has examined the effects of pre-task planning with the basic assumption that pre-task planning can minimize the cognitive burden of the writers during task performance by helping them to look for proper grammar and pragmatic structures (Schoonen, Snellings, Stevenson & van Gelderen, 2009).

Earlier research focused on the effects of planning on speaking. Most of these studies concluded that planning before speaking has positive effects on the produced language in terms of fluency and complexity; whereas results were more controversial for accuracy (Ellis, 1987; Mehnert, 1998; Ortega, 1999; Skehan & Foster, 1997). In Skehan and Foster's (1997) study, it was found that learners divided their attentional resources among all the required processes and they illustrated a trade-off effect between complexity and accuracy: learners under planning condition manifested a more complex but a less accurate language.

While there are many studies exploring the impact of planning on oral performance in EFL or ESL contexts, there are fewer studies on the effects of planning on written texts (Ellis & Yuan, 2004; Johnson, 2014). The planning studies in L2 writing focused on manipulating the timing and the planning conditions and they illustrated mixed results. Some studies showed improvement in accuracy for the condition of on-line planning, which is described as the planning that takes place during composition, (Ellis, 1987; Ellis & Yuan, 2004) whereas others showed improvement in fluency and complexity for pre-task planning condition (Ellis & Yuan, 2004). Ellis and Yuan (2004) explained this by arguing that pre-task planning helped learners in the organization of their texts while on-line planning resulted in opportunities for monitoring the texts for accuracy. However, some studies could not observe any significant difference among different planning conditions (Shi, 1998; Johnson Mercado & Acevedo, 2012; Johnson, 2014). Johnson et al. (2012) and Johnson (2014)

suggested that learner and instructional variables were potential determiners of the quality of an L2 writing rather than planning. In other words, the differences in the threshold level of the participants (a required level of L2 proficiency in order to free the demands of working memory), learners' genre knowledge and explicit instruction in the use of writing strategies might have led to mixed results in studies investigating the impact of planning on L2 writing (Johnson, 2014).

Collaborative interaction

Collaborative interaction occurs when a group of learners collaborate to construct and develop ideas. Grounded in Vygotsky's (1978) sociocultural theories of learning and specifically his notion of the Zone of Proximal Development, this interaction allows learners to provide scaffolding to each other's language use and the cognitive development of learners can enhance as a result of the interaction between less and more-able participants while completing a shared task. Collaboration generates certain advantages in process-based approach. During the planning stage, learners can collaborate to generate and organize their ideas and set goals for the given writing task while increasing the reciprocal sense of ownership (Storch, 2005). Research reveals significant improvements in meaning-based areas like content, organization and vocabulary when students plan collectively for a written assignment (Shehadeh, 2011; Lee, 2013).

Mind mapping as a pre-writing strategy

Mind maps are thinking tools that branch out from a core concept (Bozan, 2018). They can be defined as the graphical devices for organizing and drawing connections between concepts symbolized by a connecting line (Nowak & Gowin, 1984; Novak & Cañas, 2008). Illustrating relationships visually makes mind maps valuable instruments for facilitating the organization, comprehension, and recalling of knowledge. Novak (1998) argued that a good teacher helps "to move the learner beyond rote learning by negotiating meanings with the learner" and therefore considered mind maps as useful tools for instructors and students. The participants of Novak's (1998) study got more and more skilled on mind mapping reported that they were learning how to learn, experiencing meaningful learning and avoiding rote learning. Experiences of instructors in this study also showed an increased competence since mapping was helpful for planning more meaningful teaching and establishing a platform with the students to construct a meaningful interaction.

Mind mapping can be an effective pre-writing strategy that facilitates conceptual and linguistic progress. Some studies showed that mind maps that are applied as a pre-writing activity enhance the content and organization of written outputs; but not the grammatical accuracy (Abrams & Byrd, 2016; Al-Shaer, 2014; Ojima, 2006; Zhang, 2018). In some of the studies, participants indicated positive attitude towards writing due to mind mapping (Zhang, 2018). Furthermore, collaboratively constructed mind maps significantly improved content, organization, and vocabulary of written products compared to no planning condition (Lee, 2013). Nonetheless, Neumann and McDonough's (2015) study indicated that L2 learners may consider planning prior to the task just to "joke around" and ignore giving and receiving corrective feedback to each other (p. 99). Some participants also found paper-based mind mapping as a time-consuming activity on account of the fact that the learners might have been limited by their proficiency levels and cognitive abilities, and there could have been different variables such as the nature of the writing tasks (Ojima, 2006; Manchón & Roca de Larios, 2007; Zhang, 2018). Some mappers in Ojima (2016) and Zhang's (2018) study pointed that choosing ideas, drawing and revising mind maps took a longer time.

Computer-based mind mapping

According to Anderson-Inman and Zeitz (1993) the most difficult aspect of implementing mind mapping in the classroom is the mapping itself because students consider constructing and revising pen-and-paper mind maps "extremely difficult" (p.6). Computerized mind maps, on the other hand, can allow more practical remake of nodes and links, thus a better organization and structure of the knowledge (Liu, 2011; Reader & Hammond, 1994). They can create many opportunities for the students such as extending learning beyond the classroom, allowing collaboration among peers, allocating more time to plan texts, making the writing and revision easier, and allowing both teacher and peer feedback. Although scarce in number, research looking into the application of computer-aided mind maps especially in foreign language learning found significant improvement on produced texts under computerized mind mapping compared to the pen-and-paper format (Chiou, 2015; Liu, 2011; Sturm and Rankin-Erickson, 2002). It was also believed that the learners' positive perception towards computerized mapping decreased the cognitive burden as well as adding fun to the task (Sturm & Rankin-Erickson, 2002). Nevertheless,

Zaid's (2011) study associated computerized mapping tools with significantly greater anxiety because of their demanding, innovative and sophisticated nature.

The current research aimed to examine the effects of collaborative and individual computerized mind mapping as a pre-writing activity on the writing output produced by university level EFL students enrolled in intermediate reading and writing classes. With the foci on student surveys and semi-structured interviews, the present study also aims to explore learners' perceptions towards computerized mind mapping. The questions guiding the research are as follows:

1. What are the impacts of different degrees of computerized mind mapping (no-mapping, individual-mapping, and collaborative mapping) on writing performance of intermediate level EFL learners in terms of content, organization, vocabulary, language use, and mechanics?

2. What are the students' perceptions towards computerized mind mapping as a pre-writing activity?

Method

Context and participants

The data for this study was collected from the school of foreign languages at a state university in Istanbul, Turkey in 2018. Participants were 45 intermediate-level EFL students from three intact classrooms of Reading and Writing lectures. The students were assigned by the school administration to different classes according to their English language levels. All participants who were B2 level English language learners according to Common European Framework of Reference had limited writing experience in English, and were considered as novice writers. Participants were informed at the beginning of the study and they were requested to fill in the inventory of English language learning in order to document their language background. Table 1 summarizes the background information of the participants. All the participants indicated that they learned Turkish as their native language and started learning English in the fourth grade of primary school. The researcher/instructor was the responsible teacher for Reading and Writing lessons of two experimental groups, which were assigned to collaborative mind mapping and individual mind mapping groups. Another instructor, who had an experience of ten years of teaching, was the Reading and Writing teacher of the control group. All three groups received the same training and used

the same textbooks except that the experimental groups were additionally trained on how to use mind maps in a computer laboratory and they produced mind maps outside the classroom. The semi-structured interview participants were both from collaborative (n = 7) and individual mind mapping groups (n = 5) and they were selected through convenience sampling method.

Table 1. The distribution of the participants in terms of gender and departments

	Gender		Departments												
	M	**F**	**Hist***	**MBG***	**PS***	**BA**	**EE**	**Gast**	**HM**	**IDS**	**Phil**	**PhyE**	**CPSY**	**Soc**	**TL**
Ind	6	9	6	4	2				1		1			1	
Col	8	7	3	5	2		1		1			1	1		1
Control	6	9	4	2	4	1	1	1	1	1					

Note. The departments of History, Molecular Biology and Genetics, and Political Science use English as medium of instruction. Other departments (Electrics and Electronic Engineering, Gastronomy, Health Management, Information and Document Analysis, Philosophy, Physics Engineering, Psychological Counseling, Sociology, and Turkish Language) use Turkish as a medium of instruction.

Data collection and procedure

An explanatory sequential mixed methods design in which a quantitative phase was followed by a qualitative one was used to collect data in this study. The quantitative data provided a general understanding of the research problem through statistical results while qualitative data (semi-structured interviews) assisted in getting mappers' feedbacks. As the first phase, non-equivalent control group pretest/posttest design was employed. Three classes consisting of the participants assigned by school administration were selected as control and two treatment groups. Before collecting data, experimental group participants were informed on researcher's purpose of the study. Both the non-equivalent control group and the two treatment groups were asked to complete a survey at the beginning and at the end of the study. The survey intended to collect information on allocated time for pre-writing, the importance given to pre-writing stage, the satisfaction level for allotted planning time and preference of pre-writing mode. 34 participants responded the pre-survey while 45 participants responded the post-survey.

Two exposition (cause and effect, compare and contrast) and one argument task (opinion) were utilized as writing prompts in the production of essays. The participants were first instructed on the particular essay type with reading materials, sample essays, vocabulary and grammar exercises appropriate to the related topic. They were allowed to

ask questions in their native language since they were not familiar with the structure of an essay. After the explicit instruction, the students were given two different writing topics for each type of essay. During the study, all students were asked to choose one of the topics and to start their essay following the explicit structure the institution demanded. Participants were asked to write an opinion essay prior to writing the actual assignments to become familiarized with essay writing. This essay was named as task 0 which enabled the researchers to assess participants' initial writing skills. On the third week, experimental groups were additionally trained on how to use the computerized mind mapping tool in the computer laboratory and were guided on how to register and edit the expert skeleton mind maps, how to insert topic and relationships, how to add icons or images. Each participant was provided with an explanation on the benefits of completing a computerized mind map such as planning the organization and the content easily, searching for more information on related topic, and utilizing teacher feedback. Meanwhile, the control group participants followed traditional prewriting activities in the classroom. The activities included brainstorming or outlining for the essay topic that they would begin writing. The activities of the students were not checked or evaluated.

Different from individual mappers, the collaborative concept mapping group was also informed that both group members could have access to the map at the same time and give feedback to one another. These mappers were allowed to choose their pairs. As part of collaboration, pairs were expected to share their ideas on a single map and give content-based feedback to each other. The history of changes on the tool allowed the instructor to keep track of the individual contributions on a single map. The collaborative mappers produced their concept maps in pairs, yet they were asked to write their essays individually. After each mind mapping activity, the instructor/researcher reviewed the maps, gave content-based feedback in terms of the quality of the ideas. Three writing assignments a) opinion essay (task 1), b) compare and contrast essay (task 2), and c) cause and effect essay (task 3) were completed after the computerized mapping training in the experimental groups.

The topics for the assignments were announced one week before the writing task for all groups. The experimental groups were expected to plan their essays using computerized mind maps prior to the writing tasks at home and to review the feedback given. Mindomo was the selected online mind mapping tool for this study. This web-based mind mapping device has affordances such as allowing students to use pre-designed mind maps individually or collaboratively, to add images from the web to the map, to record video or audio, and to chat online. The experimental groups worked on these maps by adding or removing the concepts. Participants in one of the treatment groups completed all of their computerized mind maps in pairs collaboratively and participants in the other one completed them individually. Appendix A illustrates some examples of individual and collaborative maps. The control group received the same instruction on essay writing; yet they did not use mind mapping and did not receive any kind of teacher feedback before writing their essays. All participants wrote their essays as a first draft in a one-hour class, under the inspection of their instructor and submitted their drafts at the end of the class. They were subsequently given correction codes and asked to write a second draft at home, which are not a part of this study.

As the second phase, a semi-structured retrospective interview was conducted with the twelve participants who volunteered. The interview questions aimed to gain insight about: (1) participants' perceptions of pre-writing activities before and after the experiment, (2) whether they used the mind maps, and if they did, to what extent, (3) the most interesting and difficult parts they found of the mapping, (4) whether they would have preferred to work alone or with partners and (5) whether the mind-mapping activity had an impact on their confidence in writing or on other language skills. The interviews were conducted in Turkish, the native language of the participants, to allow them to provide more in depth answers. Interviews were audiotaped and transcribed for the analysis. Table 2 illustrates the process of data collection in brief:

Table 2. Summary of data collection

	The Experimental Groups	**The Control Group**
1st Week (2-6 April)	Completion of consent form, the inventory of English language learning and pre-survey Introduction to Essays (From Paragraph to Essay Writing)	Completion of consent form, the inventory of English language learning, and pre-survey Introduction to Essays (From Paragraph to Essay Writing)
2nd Week (9-13 April)	Instruction on opinion essay Task 0: Writing an opinion essay	Instruction on opinion essay Task 0: Writing an opinion essay
3rd Week (16-20 April)	Instruction on opinion essay cont. + Computerized mind mapping in computer labs (cont. at home)	Instruction on opinion essay cont.
4th Week (23-27 April)	1st task: Writing an opinion essay	1st task: Writing an opinion essay
5th Week (30 Apr – 4 May)	Instruction on compare and/or contrast essay + Computerized mind mapping (at home)	Instruction on compare and/or contrast essay
6th Week (7-11 May)	2nd task: Writing a compare and/or contrast essay	2nd task: Writing a compare and/or contrast essay
7th Week (14-18 May)	Instruction on cause and effect essay + Computerized mind mapping (at home)	Instruction on cause and effect essay
8th Week (21 – 25 May)	3rd task: Writing a cause and effect essay Completion of post-survey and semi-structured interviews	3rd task: Writing a cause and effect essay Completion of post-survey

Data Analysis

The analytic scoring rubric of Jacobs et al. (1981), one of the most widely used scales in ESL studies, was selected to grade the written essays. This rubric, also known as ESL Composition Profile, is divided into five sections: content, organization, vocabulary, language use, and mechanics (see Appendix B). The 166 hand-written essays were transferred to digital environment and were checked for plagiarism and none of the essays were detected for copying from another source. The names of the students were replaced with pseudo names for the confidentiality purposes. One rater graded all the essays while another rated 50% of the written essays that were randomly selected from each group in order to construct inter-rater reliability. Before the grading, a rater training was held in three sessions. First, the raters examined the scoring rubric of Jacobs et al. (1981) and evaluated some essays which were not included in the study. Then they discussed their scores with one another. Finally, they started scoring the essays in separate settings and they wrote down their scores in an excel file. The inter-rater reliability was calculated in IBM SPSS for 50% of

the scored essays by looking at Pearson Correlation Coefficient. All measures indicated more than 88% reliability. Only the scores of the first rater were used for further statistics.

In order to answer the first research question, the five different scores for four different tasks were calculated in IBM SPSS 21.0. The study consisted of 45 intermediate-level EFL students from three intact classrooms. Since the sample size was small (n = 15 for each group), the present study utilized non-parametric tests, namely, the Kruskal-Wallis test and the Mann-Whitney Test, which are based on ranked data. Descriptive statistics including means, standard deviations, medians, minimum and maximum grades were analysed for three groups distinctively. The Kruskal-Wallis test was run to find out whether there was a significant difference among three groups. Significance for this test was determined by Monte Carlo p value and if there is a significant difference (i.e. $p < .05$), the Mann-Whitney Test was conducted to identify where the difference lies. In order to control for Type I errors, a Bonferroni correction was applied. It was attained through the p value divided by number of tests, which would lead to the new critical level of significance as .05/3 = .0167. The results from each Mann-Whitney test were reported using median, test statistic (U), the corresponding z, the significance value, and effect size.

The significance value shows results either as significant or not significant, yet the effect size is more informative since this size shows "an estimate of the extent to which two variables are actually related" (Plonsky & Oswald, 2014, p. 3). Since it was more meaningful to calculate the effect sizes of the focused comparison (i.e. two groups) rather than yielding the general effect of all groups, Mann-Whitney tests were utilized in the present study (Field, 2009). Pearson's r was calculated by following formula: z scores of each comparison were divided by the total number of observations (in the present study, two groups of 15 make 30 observations). Plonsky and Oswald (2014) also attributed new benchmarks for the interpretation of effect sizes which are considered more appropriate for L2 research. The new effect sizes were interpreted by following r sizes: .25 as small, .40 as medium and .60 as large. Monte Carlo method also illustrates a confidence interval for significance, which can confirm the range of exact p value with 99% confidence (Field, 2009). In order to indicate a genuine difference, the confidence interval for significance was checked. If the boundary of the confidence interval for significance does not exceed the significance value, it indicates 99% confidence that the significant effect is real. On the other hand, if the significance value falls

within the boundary of this interval, it can be interpreted that the effect cannot genuinely tell the difference. As a result, the present study not only indicated the Monte Carlo p value, but also illustrated the magnitude of the effect size with new benchmarks (Plonsky & Oswald, 2014) and 99% confidence interval for significance of 10000 Monte Carlo samples in order to attain more meaningful interpretation of the results.

In order to answer second research question, the results of the survey based on the perceptions and experience of the writing activities were analysed. Descriptive statistics was used to analyse Likert-scale questions. Moreover, the themes that emerged in the semi-structured interviews were grouped and explained with verbatim excerpts. The qualitative data was expected to provide mappers' feedbacks on the use of computerized mind maps as a pre-writing activity.

Findings

The present study assessed the scores of three groups (i.e. no-mapping, individual mapping and collaborative mapping) according to the ESL Composition Profile of Jacobs et al. (1981). The results of the quantitative data are reported for four tasks: task 0, task 1, task 2 and task 3. For the first part, the five subcomponents were analysed by dividing no mapping, individual mapping and collaborative mapping groups with split file. The Kruskal-Wallis test was executed since there were three independent groups, yet it did not reveal a statistically significant difference in writing performance across three different groups in terms of content, $H(2) = .728$, $p = .70$; organization, $H(2) = 1.141$, $p = .58$; vocabulary, $H(2) = .433$, $p = .81$; language use, $H(2) = 1.880$, $p = .41$; and mechanics, $H(2) = 1.036$, $p = .59$ for the task 0. It can be deduced that, before the experiment, the three groups did not differ from one another in writing performance according to content, organization, vocabulary, language use and mechanics.

When the Kruskal-Wallis test was calculated for the following three tasks, no significant difference was found on the writing performance among three groups for vocabulary, language use and mechanics. However, writing performance was significantly affected by mapping condition in terms of content and organization. Table 3 summarizes the results of Kruskal-Wallis test for three tasks by reporting test statistic (H), its degrees of freedom and its significance. The confidence interval for significance was also observed and

the exact *p* value was contained within the boundaries both for content and organization with 99% confidence. This led to post-hoc tests for content and organization criteria in order to find where the difference lies.

Table 3. Kruskal wallis test results for three tasks

	Task 1			Task 2			Task 3		
	H	df	*P*	H	df	*p*	H	df	*p*
Content	6.352	2	.039*	9.881	2	.006**	9.402	2	.009**
Organization	6.203	2	.044*	8.585	2	.012*	6.692	2	.035*
Vocabulary	3.765	2	.156	3.589	2	.170	4.920	2	.084
Lang Use	1.831	2	.406	.367	2	.834	2.025	2	.367
Mechanics	.271	2	.885	2.596	2	.279	.508	2	.786

*$p < .05$; **$p < .01$.

The Mann-Whitney test was used to identify the differences in terms of content and organization separately for each task. Firstly, the Mann-Whitney test was calculated in terms of content. A Bonferroni correction was applied and so all effects were reported at a .0167 level of significance. Table 4 reports Mann-Whitney U Test results regarding content in all three tasks.

Table 4. Mann-Whitney u test results in terms of content

	Task 1				Task 2				Task 3			
Group	U	z	*p*	*R*	U	z	*p*	*r*	U	Z	*p*	*r*
Ind - Cont	53.00	-2.48	.010*	-.45	50.50	-2.58	.008*	-.47	47.50	-2.71	.007*	-.50
Col - Cont	79.50	-1.38	.18	-.25	45.00	-2.83	.004*	-.52	71.00	-1.74	.089	-.31
Ind - Col	84.50	-1.17	.25	-.21	100.50	-.50	.62	-.09	65.00	-1.98	.046	-.36

*$p < .0167$

No statistically significant difference was found between individual mappers and collaborative mappers when the content of the written essays was considered. On the other hand, individual mappers had higher content scores than no mapping group in all tasks (task 1: U= 53.00, p = .010; task 2: U= 50.50, p = .008; task 3: U = 47.50, p = .007). The effect size was medium between individual and control group for all tasks (task 1: r = -.45; task 2: r = -.47; task 3: r = -.50). Finally, the content wise comparison indicated no statistically significant difference between collaborative mapping group and no mapping group for the first and the third task, but collaborative mappers illustrated higher content scores than no mappers (i.e. control group) in compare and contrast essays (i.e. task 2), U= 45.00, p = .004. The effect size was also between medium to high in the second task, r = -.52. We can conclude that

individual mapping condition had beneficial effects on writing performance in terms of content in comparison to no-mapping condition in all essay types. Collaborative mappers, on the other hand, had better content scores only in compare and contrast essays compared to control group. It appeared that there was no significant difference in the content scores between individual and collaborative mind mappers.

Another Mann-Whitney test was used for organization scores and these results were parallel to the results of content scores. A Bonferroni adjustment was applied and all effects were reported at a .0167 level of significance. Table 5 shows test results for organization in three tasks.

Table 5. Mann-Whitney u test results in terms of organization

	Task 1				Task 2				Task 3			
Group	U	z	*p*	*R*	U	z	*p*	*r*	U	z	*p*	*r*
Ind - Cont	50.50	-2.58	.010*	-.47	55.00	-2.40	.014*	-.44	56.00	-2.36	.016*	-.43
Col - Cont	82.00	-1.27	.21	-.23	50.50	-2.60	.009*	-.47	65.00	-1.99	.05	-.36
Ind - Col	89.00	-.98	.35	-.18	95.00	-.73	.48	-.13	96.50	-.67	.51	-.12

*$p < .0167$

In terms of organization, there was no statistically significant difference between individual mappers and collaborative mappers in all three tasks. However, individual mappers organized their essays significantly better than no mappers (task 1: U= 50.50, p = .010; task 2: U= 55.00, p = .014; task 3: U = 56.00, p = .016). Moreover, this measure had medium level effect size for each task (task 1: r = -.47; task 2: r = -.44; task 3: r = -.43). Lastly, the organization scores of the collaborative mappers were significantly higher than no mappers in the second task, U = 50.50, p = .009, r = -.47, but there was no significant difference between them for task 1 and task 3. As a conclusion, individual mind mapping had a significant impact on organization of all essay types when used as a pre-writing activity compared to no mapping. Compared to control group, collaborative mapping users only had significantly better organization scores in compare and contrast essay task, but not for opinion and cause and effect tasks. There was no significant difference on the organization scores of three tasks between individual and collaborative mapping conditions.

To sum up, the three groups did not differ from one another in writing performance according to content, organization, vocabulary, language use or mechanics before the experiment. After using mind mapping as a pre-writing activity, participants in the

individual mapping condition had significant improvement in writing performance in terms of content and organization compared to no-mapping condition in all essay tasks. In comparison to control group, participants in collaborative mind-mapping condition also had a positive improvement in compare and contrast essays in terms of content and organization, but not for opinion and cause and effect tasks. The results did not reveal any significant difference between essays produced through individually completed computerized mind maps and collaboratively constructed computerized mind maps in terms of Jacobs et al. (1981) composition profile scores.

A pre and a post survey were given to participants to explore their perceptions of pre-writing activities. Firstly, they were asked to report the time they spent on planning their essays. According to the pre-survey results, the majority of the participants from all three groups reported that they plan less than twenty-one minutes. After the treatment, the groups were asked the same question and while the majority of the control group still indicated that they plan less than twenty-one minutes, many mappers reported more time for planning. Additionally, in the post-survey, experimental groups were asked about the mode (individual vs. collaborative) they would prefer to construct a mind map were they given a choice. 11 participants in the individual mapping group showed preference for individual construction while only 4 of them preferred working in pairs. 9 participants in the collaborative mapping group, on the other hand, preferred mind mapping individually whereas 6 of them chose to work in pairs. The results revealed that more than half of the collaborative mappers would prefer to construct their own maps individually were they given a choice.

Finally, the semi-structured retrospective interviews help us see some views on pre-writing and computerized mind mapping in EFL classes. The responses were divided into themes such as the opinions on pre-writing stage, computerized mind mapping, collaboration and individual work and finally, language skills. The interview revealed that only some participants were familiar with pre-writing activities and planning before writing the essays was found to be important and useful in many ways by 11 participants (only 1 person did not find it important). Most common themes on the views on pre-writing stage were organization and research. 5 respondents associated pre-writing activity with working systematically, categorization or organization. 3 interviewees defined mind mapping activity

leading to more in-depth research, as well. They emphasized searching other websites, learning new information, and making a progress on the topic through planning before writing. All in all, the pre-writing stage was considered to be essential especially for improving the organization of the compositions and enabling in-depth research on the topic. As for their views on computerized mind mapping, participants were asked whether and to what extent they consulted their mind maps during actual writing. While all the individual mappers (n = 5) expressed they used them in all their essays, only 2 collaborative mappers (n = 7) indicated to do so. Others revealed the reason for not benefiting from the mind maps for all essays due to time limitation and conflicts with peers. The most interesting aspects of computerized mapping tool were supporting learning styles (i.e. visual learners) and the affordances of the tool (i.e. easy to access, easy to search info, saving automatically, chat application). The most difficult aspects were technical problems such as making the fonts bigger, no undo button, and deleting some words. To sum up, most respondents found computerized mind mapping interesting and informative thanks to its affordances, yet there are some problems on the technical level of the tool that might be improved in the future. When the participants were asked what mode they would prefer, a majority expressed studying individually. The task conditions (planning collaboratively, writing individually) and the personality of people were influencing factors to lead the users to individual mind mapping. There were also other participants who favored sharing information exchange and brainstorming with others during mind mapping, but some of their experiences were in a limited extent. Rabia defined collaboration in the expressed limited scope by stating:

> *Firstly, I spoke with my peer. I mean, we exchanged information on what we could write. I looked up the things that I was going to write on my part of the map, I searched for more information in detail on the Internet and I wrote them on the map. After that, when I was alone, I wrote more in detail.*

As it can be inferred, the exchange of information was limited to decide on the topic before the mind mapping; some mappers searched and wrote on their part of the mind maps as if it had been an individual page. The interaction part was not evident in some of the mind maps. Finally, the participants were asked on the perceived impact of computerized mind mapping on their language skills. 10 out of 12 expressed their confidence in writing increased after mind mapping. They described mind mapping as a comfortable, fun,

intriguing and anxiety-reducing activity. 7 participants indicated an improvement in their reading, comprehension and translation skills. Although 2 interviewees also admitted increased confidence in their speaking skills, one mapper indicated they mostly spoke in their native language. None of them expressed a link between listening and mind mapping.

Discussion and Conclusion

The findings revealed that students using individual computerized mind maps had better scores in all tasks in terms of content and organization than no mappers. This finding is consistent with the previous findings (Abrams & Byrd, 2016; Al-Shaer, 2014; Lee, 2013; Liu, 2011; Ojima, 2006; Sturm & Rankin-Erickson, 2002; Zhang, 2018; Zaid, 2011) which illustrated that the implementation of mind mapping was helpful especially for generating and organizing ideas. The findings from interview data also supported that many learners considered mind mapping necessary particularly in terms of organizing and searching for information. As Flower and Hayes (1981) indicated, planning can aid to reduce the cognitive burden by generating, organizing ideas and goal setting and lead to better compositions. However, it would not be accurate all the credits to mapping itself. The improvements in the essays of individual mappers might be moderated by direct instruction in the use of writing strategies (Johnson, 2014). In other words, the information embedded in the mapping training and the availability of content-based feedback opportunity might have also led to better writing for all three tasks, not particularly constructing computerized maps.

The results suggested that collaborative mind mapping group outperformed the control group in compare and contrast essay task in terms of content and organization, but not in the other two tasks. The interviews and survey responses were reviewed to observe why collaborative mind mapping was not helpful in all tasks. First of all, the collaborative group participants of the interview described their experience of collaboration in a limited scope. As illustrated in interview responses earlier, the collaboration was mainly restricted to the selection of appropriate topics prior to the mapping activity. During mind mapping, the individuals preferred to write down their own part of the map as if it had been an individual one. Secondly, the interviews revealed that the differentiation in task requirements (i.e. planning collaboratively, writing individually) might have resulted in limited collaboration. Since the participants were evaluated individually for their written output, some of them

might not have wanted to share their opinions with others. Finally, some respondents expressed their timid personality as the reason for not writing their ideas even in an online platform. Only 2 collaborative mapping interviewees indicated that they used their maps for all essay tasks, which shows the majority did not want to consult to their maps during writing. The survey results also confirmed that 9 out of 15 mappers would prefer individual mind mapping were they given a chance. The results indicated that some mappers did not prefer collaborative computerized mapping and the collaborative mapping strategy did not provide any significant improvements for opinion and cause and effect essay tasks. The learners might have had reservations for collaborative activities since they had limited collaborative learning experiences. The findings revealed an improvement for collaborative mappers only for the second task in terms of content and organization. This result partially supports Lee (2013) who expressed a positive influence on the collaboratively written works for meaning-based areas like content, organization, and vocabulary. The present study, on the other hand, did not reveal a significant improvement on vocabulary as Lee (2013) suggested and this can be due to the design of the study because the present study allowed the use of a dictionary during the writing stage in classrooms for all conditions. Since all participants were allowed to consult the dictionaries, the study failed to differentiate an improvement in the knowledge of vocabulary across control and experimental groups.

There was not any significant difference on the performance of individual and collaborative mappers, and this finding is consistent with previous studies (Chiou, 2015; Lee, 2013; Liu, 2011). The effect of collaboration may not have been observed due to the inefficient implementation of collaboration between partners. For instance, some interviewees expressed using collaborative mind maps by separating the responsibilities between collaborators. Therefore, they might have constructed two maps on one mapping screen rather than one joint map.

Finally, the semi-structured interviews and the survey support that participants had positive attitudes towards writing after computerized mind mapping. The learners of experimental group expressed they enjoyed working on mind maps. Therefore, these results supported previous studies (Chiou, 2015; Ojima, 2006; Sturm & Rankin-Erickson, 2002; Zhang, 2018). The computerized mind mapping removed the problem of time experienced during planning, which was encountered in the studies of some scholars like Ojima (2006)

and Zhang (2018). The participants expressed that they liked the mapping activity without any space or time restrictions. The present study suggests computerized mind mapping extends the learning outside the classroom and makes learners active participants in searching and figuring out their interests. While some scholars such as Chiou (2015) and Sturm and Rankin-Erickson (2002) witnessed a positive attitude towards writing, Zaid (2011) observed a boost in the level of learners' writing anxiety due to the novelty and intricacy of the digital pre-writing activities. The present study was consistent with the studies of Chiou (2015) and Sturm and Rankin-Erickson (2002). The implemented mind mapping platform was described as easy-to-use and access; as a result, the mappers did not indicate any anxiety due to the tool.

Pedagogical Implications

Flower and Hayes (1981) constructed cognitive writing models to attract writing scholars' attention to writing-as-process approach. In the present study, learners' content and organization significantly developed as a result of computerized mind mapping activity prior to essay writing. The survey and semi-structured interviews also support that learners express the benefits of mapping as better organization and in-depth research. As a result, those who are interested in teaching writing in EFL could provide computerized mind mapping as a strategy for the learners to acknowledge the importance of planning and improve their compositions. Language instructors can highlight writing as a process approach, specifically the pre-writing stage by providing extended planning time and giving content-based feedback. Considering the findings of this research, the instructors also ought to familiarize learners with computerized mind mapping strategy and train learners on how to make a plan properly rather than allowing some extra time to plan.

Furthermore, the present study suggests a link between inside and outside classroom activities through computerized mind mapping and as a result, endorses the technological tools for successful writing classes. Students can consider computerized mapping as an activity to extend their learning beyond the classroom. Instructors can have the opportunity to examine the ideas of these students and lead them to better written compositions through content-based feedback. They should also be aware of the availability of computers and learners' comfort level while using computerized maps.

Limitations and Recommendations for Future Research

A number of limitations that might affect the interpretation of the findings were revealed. The design of the study, quasi-experimental design, resulted in some limitations beyond the researcher's control. Firstly, the participants were assigned by school administration and the researcher did not have any control on the allocation of the students to classes. Therefore, participants could not be randomly assigned into control or experimental groups. Secondly, the level of the students was identified as intermediate based on the institution's exam, more reliable and valid exams can be used for future studies. Thirdly, the tasks and the books were selected by a group of school instructors. Therefore, the researcher could not control the differences derived from the task types. For future research, the study should be replicated with different tasks in line with the purpose of the study and valid exams such as TOEFL or IELTS can be implemented to identify each participant's proficiency levels. Fourthly, the experimental classes were instructed by researcher while the control group was taught by another instructor. Another limitation was the duration of the study, it lasted eight weeks. For future studies, the study can be replicated by allocating a longer time in order to familiarize the learners with the concept mapping and writing essays. The concept maps constructed by the learners can also be worthy of further investigation to build a clearer picture on what happens during concept mapping.

Additionally, the sample size of the study was small. The participants were 45 intermediate level EFL students whose native language was Turkish and they were studying at the preparatory school of a state university. This study should be replicated with a larger sample size so that parametric tests can be applied and progress among the tasks can be observed more accurately. Moreover, future studies can observe different proficiency level learners in other contexts to generalize the findings to other EFL populations.

Finally, collaborative mappers were allowed to choose their partners. Although most of the collaborative mapping group did not change their partners throughout the tasks, some altered their groups. These new working groups might have affected the performance of the participants. Other studies can reconsider this situation and prevent changing the partners during the experiment to eradicate the impact of group dynamics on individuals' performance in the study. In addition, the interviews suggested collaborative mappers did

not completely apply collaborative work on the concept maps. Further studies can focus on the notion of collaboration and lead the language learners to give more feedback to one another.

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Authorship Contribution Statement

Sena SEBİT: *Conceptualization, literature search, data collection, data analysis, manuscript draft, writing.*

Senem YILDIZ: *Conceptualization, design of the work, literature search, data interpretation, writing, review and editing, manuscript revision.*

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Appendix A. Examples of Collaborative and Individual Mind Maps

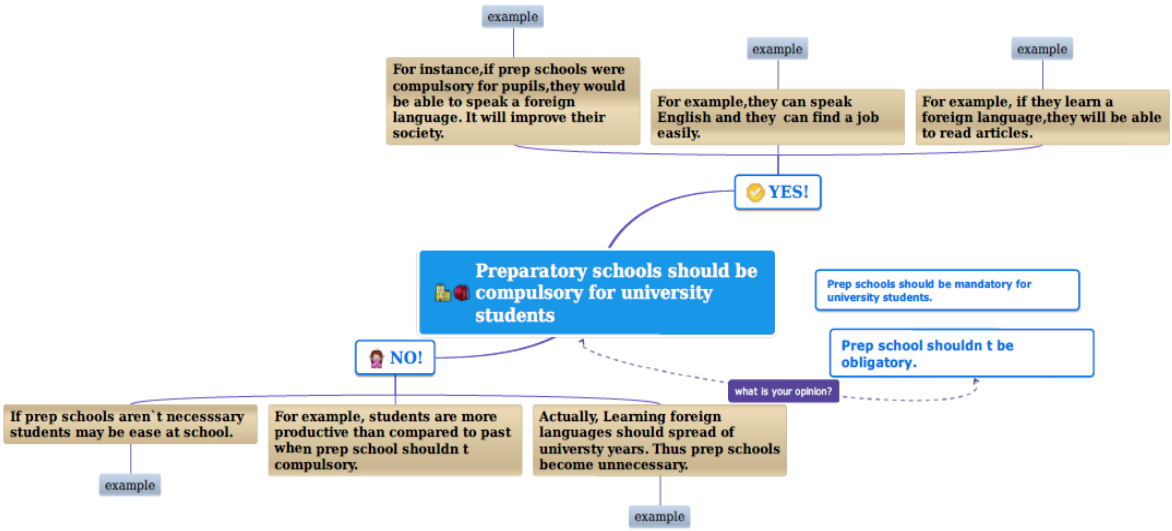

Figure 1. Erdinç and Ersoy's collaborative mind map for task 1

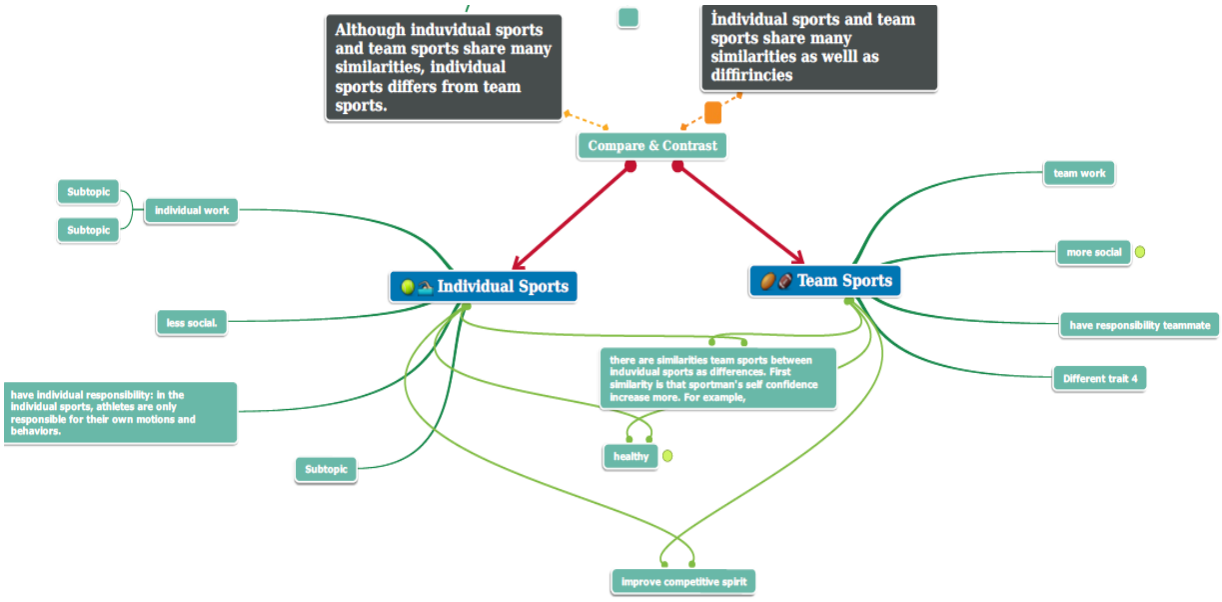

Figure 2. Munir's individual mind map for task 2

Appendix B. ESL Composition Profile of Jacobs et al. (1981)

ESL COMPOSITION PROFILE			
Score	Level	Criteria	Comments
CONTENT	30-27	EXCELLENT TO VERY GOOD: knowledgeable; substantive, thorough development of thesis; relevant to assigned topic	
	26-22	GOOD TO AVERAGE: some knowledge of subject; adequate range; limited development of thesis; mostly relevant to topic, but lacks detail	
	21-17	FAIR TO POOR: limited knowledge of subject; little substance; inadequate development of topic	
	16-13	VERY POOR: does not show knowledge of subject; non substantive; non pertinent OR not enough to evaluate	
ORGANIZATION	20-18	EXCELLENT TO VERY GOOD: fluent expression; ideas clearly stated; supported; succinct; well-organized; logical sequencing; cohesive	
	17-14	GOOD TO AVERAGE: somewhat choppy; loosely organized; organized but main ideas stand out; limited support; logical but incomplete sequencing	
	13-10	FAIR TO POOR: non-fluent; ideas confused or disconnected; lacks logical sequencing and development	
	9-7	VERY POOR: does not communicate; no organization; OR not enough to evaluate	
VOCABULARY	20-18	EXCELLENT TO VERY GOOD: sophisticated range; effective word/idiom choice and usage; word form mastery; appropriate register	
	17-14	GOOD TO AVERAGE: adequate range; occasional errors of word/idiom form, choice, usage *but meaning not obscured*	
	13-10	FAIR TO POOR: limited range; frequent errors of word/idiom form, choice, usage; *meaning confused or obscured*	
	9-7	VERY POOR:essentially translation; little knowledge of English vocabulary, idioms, word form OR not enough to evaluate	
LANGUAGE USE	25-22	EXCELLENT TO VERY GOOD: effective complex constructions; few errors of agreement, tense, number, word order/function, articles, pronouns, prepositions	
	21-18	GOOD TO AVERAGE: effective but simple constructions; minor problems in complex constructions; several errors of agreement; number, tense, word order, articles, pronouns, prepositions *but meaning seldom obscured*	
	17-11	FAIR TO POOR: major problems in simple/complex constructions; frequent errors of negation, agreement, tense, number, word order/function, articles, pronouns, prepositions and/or fragments , run-ons, deletions; *meaning confused or obscured*	
	10-5	VERY POOR: virtually no mastery of sentence construction rules; text dominated by errors; does not communicate; OR not enough to evaluate	
MECHANICS	5	EXCELLENT TO VERY GOOD: demonstrates mastery conventions; few errors of spelling, punctuation, capitalization, paragraphing	
	4	GOOD TO AVERAGE: occasional errors of spelling, punctuation, capitalization, paragraphing *but meaning not obscured*	
	3	FAIR TO POOR: frequent errors of spelling, punctuation, capitalization, paragraphing; *meaning confused or obscured*	
	2	VERY POOR: no mastery of conventions; dominated by errors of spelling, punctuation, capitalization, paragraphing OR not enough to evaluate	
Total score	Reader	Comments	