

CONCEPT MAPPING AND WRITING

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Abstract. The writing process can benefit from applying external representations, such as outlines, or other graphic organizers, such as concept maps. We propose, based on Flower and Hayes' (1981) writing model, that there is value to instructing students, in the planning stage of writing, in employing concept mapping techniques: to elicit prior knowledge and brainstorm an issue, to organize ideas, and to develop writing plans. We present an intervention study to evaluate these ideas. It appears that concept mapping instruction and application during pre-writing contributed to the accessing and use of prior knowledge for written essays and improved their rhetorical structure in comparison to a control instruction.

1 Introduction

Writing can be viewed as a complex problem solving process, where a problem is some times ill-defined, and so is the expected product. We use tools to solve problems. They can be tools for calculation, for simulation, or for representing the problem. All those are cognitive tools. Can writing be aided by using cognitive tools, such as concept mapping? Writing or composing is a complex cognitive process and requires assembling many cognitive resources and juggling many constraints. Writing receives considerable attention in education, literary, and linguistic literature. But the many studies in there are mostly qualitative, descriptive, and prescriptive research. Traditional models of writing (e.g., Rohman, 1965) describe discrete stages of writing, such as Pre-Writing (before words are crafted on paper or screen), Writing (a physical product is created), and Re-Writing (modifying and editing the product). While such models are convenient for instructional purposes, and indeed, identifying the Pre-Writing stage, aided instructors in devising composition curricula and identifying components of this stage, such as goal setting, knowledge assembly, idea generation, and organizing the writing plan, stage models have not captured the entire complexity of the writing project.

Among theories about writing processes, Flower and Hayes' (1981) cognitive process model of writing is one of the first and best known. It provides a relatively comprehensive framework for research and application (see Figure 1). The diagram identifies various cognitive structures and processes of the writing environment. It consists of an external task environment and an internal memory structure of the individual, a long-term memory and a working memory, where cognitive macro-operations are executed. These process components include planning the writing act, translating the plan into a produced text, and reviewing and editing the product. The processes are not necessarily sequential, with component processes embedded within other components, forming a recursive-like chain of operations. Further developments of process writing models include Hayes' (1996) refinement of the basic processes, distinguishing in the external task environment between a physical and a social environment. In the physical environment a further distinction is made between the content of the text produced so far and the given medium (i.e., paper vs. screen) that may alter the writing process and its products. In the social environment a further distinction is made between audience and collaborators. Reviews of additional writing models based on cognitive processes can be found in Becker (2006) and Galbraith (2009).

We focus on the planning of writing. Planning activities occur throughout the entire writing process, however, they are more evident at the beginning of the project, when the writing assignment is provided, and gradually decline at later phases while revision activities increase (Kellogg, 1988). Flower and Hayes (1981) identify three planning activities that we address in our research: *generating ideas*, *organizing*, and *goal setting*. *Idea generation* is based on those ideas that can be retrieved or generated from stored knowledge in long-term memory, or from accessing external, provided or selected sources, and even from the social environment. When time is constrained, like in standard writing assessments in academic settings, the writer relies mostly on previous knowledge and given resources. So, for example, when a student is asked to write about "What have we gained and what have we lost by using mobile phones?" she accesses her memory about mobile phones past experiences, her general knowledge about what mobile phones are, and recollected claims for or against mobile phone use. External resources, such as texts or (classroom) discussion, may provide additional data and stances (in argumentative writing) about mobile phone use. Following or intermixed with idea generation is an *organization activity* that **classifies** the generated ideas, according to her analysis of the writing assignment: Content: Mobile phone, Form: Pro-Con. Gradually, a *writing goal (plan)* is set, based on stored knowledge and

analysis of the writing assignment. These are rhetorical plans that include analysis of the expected audience and other writing constraints like space limitations, and medium concerns.

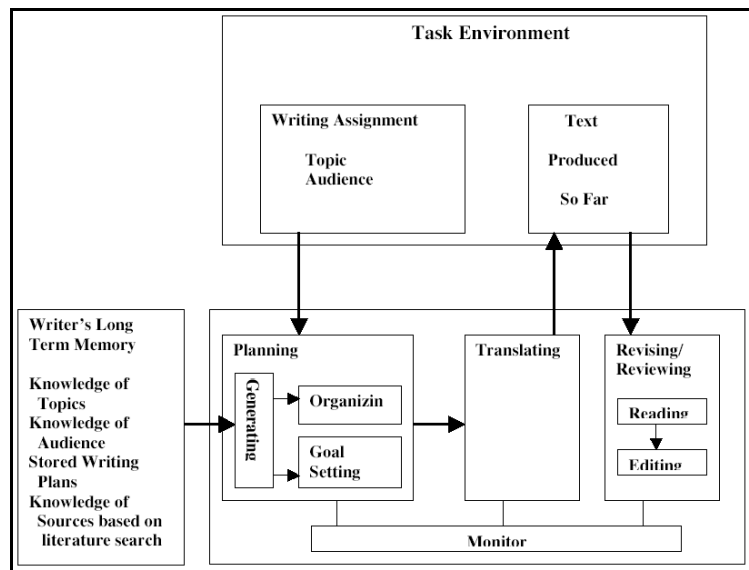


Figure 1. Flower and Hayes (1981) structure of a writing model

How can the planning process be supported? A natural candidate is concept mapping. Concept mapping is advocated as a strategy for knowledge elicitation and re-conceptualization (Cañas et al, 2003; Novak, 2010; Novak & Cañas, 2003). As such, it can also be utilized for studying textual and other media sources, by adding map structuring capabilities (Kozminsky et al, 2010), similar to the Jonassen et al (1993) proposal to represent structural knowledge. The original Novak and Gowin (1984) concept mapping idea was primarily aimed at knowledge work. They recommended constructing maps in a descriptive format, relating knowledge elements (propositions) to each other. The map is heterarchical in the sense that it originate in a focal question that designates a root proposition. From there the map is constructed by probing the student's (or the expert's) knowledge base, adding new nodes (propositions) and relating them to previously constructed ones, describing the retrieved knowledge in a network like fashion. For the purpose of learning from texts, Kozminsky et al (2010) proposed distinguishing between initially constructing descriptive concept maps, starting with prior knowledge activation and then adding text's content. The descriptive map is then transformed into more structured maps, depicting the content and the rhetorical organization of the text.

We propose to apply a similar procedure to writing, specifically at the planning phase. While instructing students in applying concept mapping to the writing process, we first ask students to brainstorm the writing assignment topic (e.g., Mobile phones), while constructing a descriptive map (Figure 2). Then, based on the assignment, the students classify relevant information from the descriptive map into an organized map (e.g., Pro vs. Con elements, Figure 3). The final step is to adapt the organized map into one that corresponds to a writing plan (Figure 4). We have not found many empirical studies that explore concept mapping in writing (e.g., Ojima, 2006, for Japanese ESL writers). Lee et al (2007) analyzed the possibilities of applying concept mapping with writers of divergent abilities. This analysis is based on Ainsworth's (2006) framework for learning with multiple representations. We present an intervention study in which student teachers in an argumentative writing class were instructed to apply concept mapping during the planning stage of writing. We asked whether the quality of their writing products changed compared with control classes.

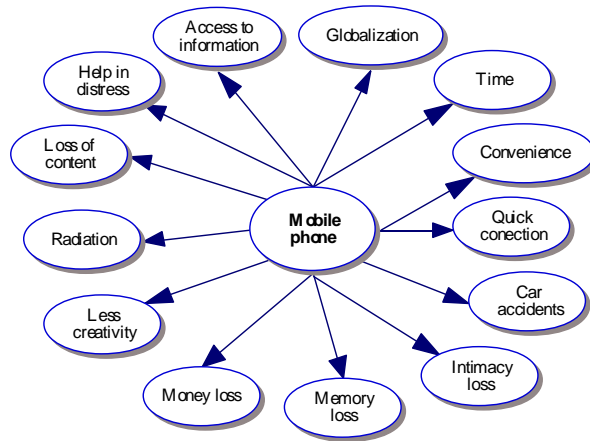


Figure 2. A descriptive (brainstorming) map example

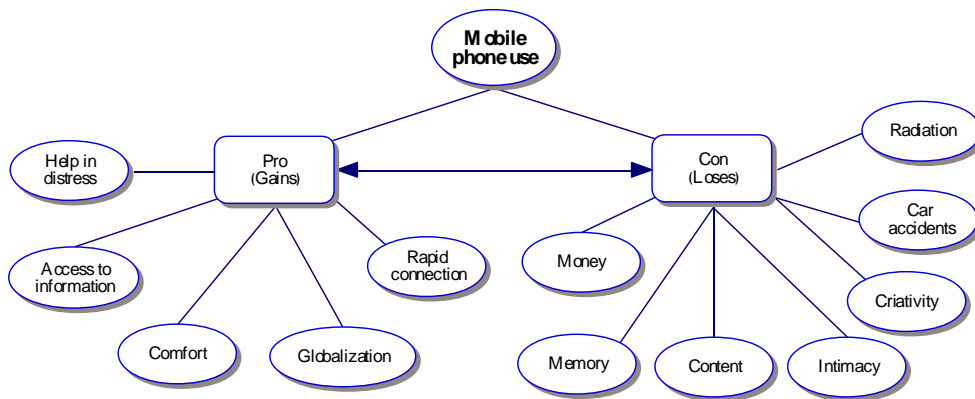


Figure 3. Classification map example.

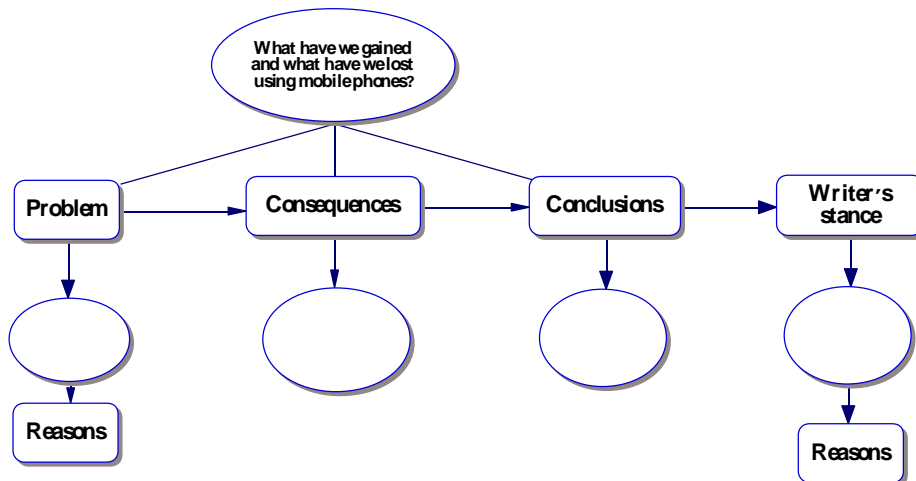


Figure 4. Writing plan (argumentation) scheme.

2 Method

2.1 Participants

49 students (mostly with teaching experience in elementary and middle schools) enrolled in semester writing workshops at an academic teachers college in Israel, taught by the same teacher. The students signed into one of

three workshops according to their preference of the workshop label, their time constraints and enrolment limitations.

2.2 *Testing instruments and materials*

2.2.1 Background information

Background information (16 items) was initially collected about the participants teaching experience and seniority, teaching subjects, language of teaching, and college seniority. Additional information was collected about their teaching practices, their familiarity with, and personal and instructional applications of graphic organizers in teaching.

2.2.2 Reading comprehension test

The test consists of two argumentative texts (400 and 700 words). Four questions were composed for each text: main idea, text structure, writer's and reader's stance on the text's issue. Each question was scored 0 (no or wrong answer), 1 (partial answer), or 2 (full answer) (Maximum score 16). The questions were answered immediately following reading. Testing time was one hour. The short text was read first and then the longer one.

2.2.3 Writing tests

The tests were composed by the researchers and were delivered before and after the intervention. It consisted of student reading two texts (about 400 and 700 words) and writing an argumentative composition on the issue provided in the texts. At the pretest the issue was Ebooks vs. printed books, and at the posttest it was providing or not providing soft drugs (e.g., cannabis) to the terminally ill. Testing time was 50 minutes, divided at the student will between reading and writing. The compositions were scored for general understanding of the issue, balanced (pro-con) and detailed argumentation, number of correct connective words, rhetorical structure (issue introduction, arguments, conclusions), writing complexity, number of correct punctuations, style, holistic evaluation, number of pro and con arguments, number of incorrect arguments (misunderstandings), number of arguments based on personal knowledge, and number of arguments based on personal misconceptions. Each criterion was scored either on quantity (i.e., number of) or on quality scale (from 0 (low) to 3 (high quality)). Each composition was independently scored by two evaluators, based on a scoring scheme. Sample comparisons of agreement between the evaluators, yielded an average of 93%. Differences were solved in a conference.

2.2.4 Procedure

The three intervention (workshop) conditions were: (1) Academic writing (Experimental) consists of learning from argumentative texts and writing argumentative essays, with the aid of concept maps; (2) Thinking and learning from texts (Control 1) consist of learning the same texts as did the experimental class, and receiving the same learning and writing assignments, but with a traditional reading and writing instruction curriculum, with no added concept mapping instruction; (3) Reading for pleasure (Control 2), consists of reading papers on the subject and prepare a project of promoting young students to read for pleasure. Research assistants observed and recorded the lessons, to ensure adherence to the predefined curriculum of each workshop.

The research was conducted during 12 weekly 90 minutes lessons. The first and the last two weeks were pre- and post testing lessons. The eight intervention lessons were divided to four instructional cycles. In the first cycle, in the experimental condition, the students were introduced to the three types of maps: A knowledge brainstorming (descriptive) map; a classification (organization) map, and an argumentation (writing plan) map, before reading. And then, guided reading of two texts (a pro and a con text, 700-800 words each) on the issue of urbanization vs. open spaces, updating the writing plan, by adding newly gained information and correcting misunderstandings, and then individual writing on the issue. The next two cycles consists of student groups' discussions that include maps construction, followed by individual reading and writing. In the last cycle all the activities were individual. The issues that were discussed were: introducing women into the workforce; mobile phone dominance in our lives, and, environmental quality in modern life. The Control 1 class studied the same issues with the same texts, learning knowledge elicitation and organization, learning about text's main idea and text structure, using the board in a traditional manner, with no graphic aids. The Control 2 class studied pleasure reading. They read texts from various genres and discuss their pleasure value. Writing was not a focus and no argumentative writing was required.

Writing Criterion	Intervention Condition	N	Pre-intervention		Post-intervention	
			Mean	SD	Mean	SD
Content (0 – 3)	Experimental	16	2.44	.63	2.31	.60
	Control-1	17	2.53	.72	2.82	.39
	Control-2	16	2.44	.73	2.25	.86
	Total	49	2.47	.68	2.47	.68
Balanced Argument (0 – 3)	Experimental	16	1.81	1.28	2.12	.72
	Control-1	17	2.35	.70	2.94	.24
	Control-2	16	1.62	.81	2.12	.81
	Total	49	1.94	.99	2.41	.73
Correct Connective Words (Number)	Experimental	16	7.44	3.56	9.56	4.57
	Control-1	17	8.18	4.77	9.53	3.95
	Control-2	16	7.12	5.45	9.25	5.80
	Total	49	7.59	4.59	9.45	4.72
Rhetorical Structure (0 – 3)	Experimental	16	1.69	.70	2.44	.63
	Control-1	17	2.41	.62	2.88	.33
	Control-2	16	2.31	.87	2.19	.54
	Total	49	2.14	.79	2.51	.58
Writing Complexity (0 – 3)	Experimental	16	2.19	.83	2.31	.60
	Control-1	17	2.47	.72	2.88	.33
	Control-2	16	2.25	.93	2.25	.77
	Total	49	2.31	.82	2.49	.65
Correct Punctuations (Number)	Experimental	16	17.94	10.32	18.31	12.68
	Control-1	17	28.94	11.86	33.41	15.62
	Control-2	16	20.50	14.40	20.12	17.34
	Total	49	22.59	12.96	24.14	16.51
Writing Style (0 – 3)	Experimental	16	2.25	.86	2.06	.68
	Control-1	17	2.53	.72	2.88	.33
	Control-2	16	2.12	1.02	2.06	.93
	Total	49	2.31	.87	2.35	.78
Holistic Evaluation (0 – 3)	Experimental	16	1.69	.70	2.19	.54
	Control-1	17	2.53	.72	2.82	.39
	Control-2	16	2.12	.96	2.25	.86
	Total	49	2.12	.86	2.43	.68
Text-based Correct Pro Arguments (Number)	Experimental	16	1.94	2.05	2.25	1.91
	Control-1	17	2.88	1.54	2.29	.85
	Control-2	16	3.44	2.25	2.69	1.40
	Total	49	2.76	2.02	2.41	1.43
Text-based Correct Con Arguments (Number)	Experimental	16	1.25	1.39	1.06	1.24
	Control-1	17	1.47	1.01	1.65	.79
	Control-2	16	1.81	1.80	1.50	1.21
	Total	49	1.51	1.42	1.41	1.10
Text-based Incorrect Arguments (Number)	Experimental	16	.00	.00	.19	.40
	Control-1	17	.00	.00	.00	.00
	Control-2	16	.06	.25	.44	.81
	Total	49	.02	.14	.20	.54
Personal Knowledge Arguments (Number)	Experimental	16	4.06	2.46	4.31	4.83
	Control-1	17	2.59	1.58	2.06	1.60
	Control-2	16	3.06	1.88	1.56	.89
	Total	49	3.22	2.05	2.63	3.13
Personal Knowledge Misconceptions (Number)	Experimental	16	.12	.34	.25	.58
	Control-1	17	.00	.00	.06	.24
	Control-2	16	.31	.60	.75	1.69
	Total	49	.14	.41	.35	1.05

Table 1: Pre- and post-intervention writing evaluation scores for the intervention groups.
(Bolded means indicate statistically significant difference ($P < .05$) from the other means)

3 Results

Since students were not randomly assigned to classes, we analyzed initial reading comprehension scores ($M = 10.39, SD = 3.04$). There was no statistical difference among the groups ($F(2, 46) = .14$). Analyses of writing criteria were performed using ANCOVAs, where the post-intervention criteria were dependent and the intervention conditions were independent variables with the respective pre-intervention criteria scores as covariates. The means and standard deviations of the writing criteria are displayed in Table 1. The analyses demonstrated the advantage of Control-1 over the experimental class in several criteria (content, argumentation, complexity, and style). The Control-2 class had more misunderstandings in their writing compared to the other classes. The experimental students had an advantage over the other classes in including personal knowledge arguments in their essays. Their rhetorical structure scores were similar to Control-1 and higher than Control-2 students.

4 Discussion

The sole effects of the concept mapping intervention at the planning stage of writing were the activation of personal prior knowledge and the introduction of its content into the essays. An example of a student concept map that depicts a gross writing plan is illustrated in Figure 5. It was constructed following brainstorming (Figure 2) and constructing a classification map (Figure 3). This map was then restructured and expanded by adding information gained from reading the textual sources and additional self knowledge elicitation, and served as a writing plan for producing a 500 word argumentation essay.

However, the advantages gained from concept mapping instruction at the planning phase were not translated into writing quality, as measured by traditional writing criteria. The class that received traditional reading and writing instruction (Control-1) fared best. We propose a time-on-task effect. Concept mapping instruction at the planning stage of writing required time resources that were diverted from teaching other elements of the writing curriculum. Perhaps, in addition to introducing concept mapping during planning, we propose that integrating concept mapping instruction within the additional phases of writing (translation and reviewing), as well as using concept mapping applications, such as Cmap Tools, may improve the prospects of this project.

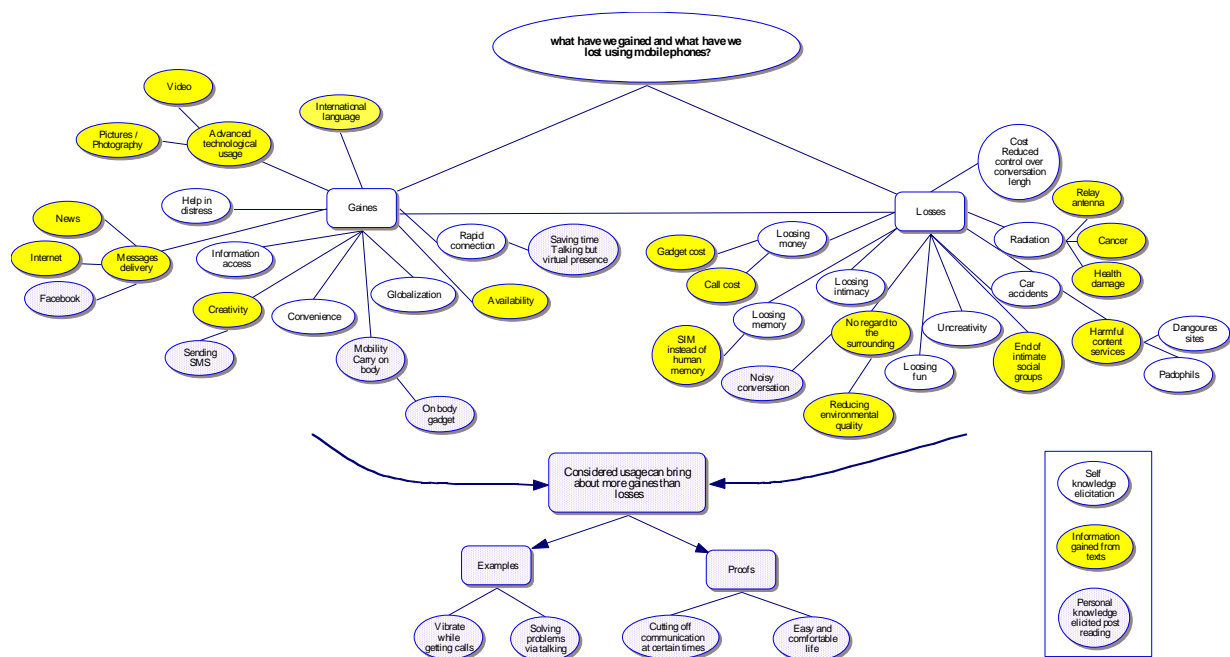


Figure 5. A concept map illustrating a student writing plan.

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