Effects of Hand-Drawn and Computer-Generated Concept Mapping on the Expository Writing of Middle School Students with Learning Disabilities

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Abstract. The purpose of this study was to examine the effects of two forms of concept mapping, hand-drawn and computer-generated, on the descriptive essay writing of middle-level students with learning disabilities. Twelve eighth-grade students composed descriptive essays under three conditions: no-map support, hand-map support, and computer-map support. The essays were compared on four measures: number of words, syntactic maturity, number of T-units, and holistic writing scores. Writing attitude was also examined. Results showed that student descriptive essays produced in the hand- and computer-mapping conditions demonstrated significant increases above baseline writing samples on number of words, number of T-units, and holistic writing scores. Carry-over effects were observed in the no-mapping condition and provide an indication that students may have acquired writing skills that generalized into their essay writing when not using maps. Results showed that students’ attitudes toward writing were significantly more positive in the computer-mapping condition when compared to no-mapping and hand-mapping conditions.

Writing involves a wide range of cognitive skills and processes. Writers must be able to keep a single theme in mind, generate products in the correct syntactic and semantic form, as well as remember and produce words correctly (Outhred, 1989). Even for the skilled writer, written language production can be a trying experience.

For students with learning disabilities, the term “writer’s block” may take on a whole new meaning. Producing fluent, written text independently can be a consistent, major problem for these students.

Skilled expository writing becomes increasingly important to all students as they enter the secondary grades. Secondary students are expected to compose longer documents, to use complex text and sentence structures, and to integrate and manipulate information from a variety of sources. Written expositions place additional, and unique, cognitive demands on student writers. Students must have knowledge of a variety of text structures, many of which are ill-defined, and must be able to employ each structure in the appropriate context (Thomas, Englert, & Gregg, 1987). While composing, they must be able simultaneously to hold in memory the text structure, the intention of the complete composition, and the previous sentence (Bereiter & Scardamalia, 1984). For students with learning disabilities (LD) who have difficulty monitoring metacognitive resources, expository writing can be especially demanding.

Skilled writers approach writing tasks by selecting writing goals, choosing topic and audience, generating ideas, and organizing their information while simultaneously engaging in a recursive movement between planning, composing, and revising processes. In contrast, research has demonstrated that students with LD have a variety of difficulties employing strategies in all phases of the writing process. Students with learning difficulties have been described as using knowledge-telling writing strategies (Bereiter & Scardamalia, 1987); they treat writing as a question-answering task, quickly telling whatever comes to mind. This ineffective strategy results in writing products that are shorter and less sophisticated.
Students who struggle with writing have been observed to have difficulty with both low-level (e.g., conventions and mechanics) and high-level (e.g., organization and generation of content) aspects of the composing process. Some written language features common to writers with LD include difficulties with conventions, handwriting, setting goals, content generation, organization and cohesion, sentence structure, and evaluating and revising their writing (MacArthur, Schwartz, & Graham, 1991; Scott, 1989). Writers with learning disabilities have been noted to focus on writing conventions (e.g., spelling) and, therefore, may be unable to effectively execute higher-level cognitive processes during the writing process (Graham et al., 1991; MacArthur & Graham, 1987). Research has demonstrated that students with LD have difficulty choosing the appropriate text structure and framing relevant information (Graham et al., 1992). In addition, from a language perspective, students with LD have been noted to demonstrate gaps in vocabulary, as well as weak word, phrase, sentence, and discourse structures (Ehren, 1994). These language difficulties have a confounding impact on both the writing and classroom performance of these students. The struggle of these students with written language and the often- accompanying poor attitude frequently results in a progressive pattern of academic failure. Research conducted by Graham, Schwartz, and MacArthur (1993) confirmed the poor attitudes of students with LD through Likert surveys and open-ended interviews. Results showed that fourth- through eighth-grade students with LD viewed writing less positively than their normally achieving counterparts and cited motivation as the most common reason for their writing difficulties.

Prewriting strategies support the writing process for all types of writing. Planning before writing has been described by Flower and Hayes (1981) as the “hero” of the writing process because it supports writers in setting goals, brainstorming, organizing ideas, and deciding text structure. As writers juggle the multiple constraints (e.g., spelling, word choice, sentence cohesion, and text coherence) of the writing process, access to content and text structure developed in planning activities may permit reallocation of cognitive resources and allow students to engage in and better monitor higher-level writing processes.

Expert writers have been noted to engage in extensive planning (Bereiter & Scardamalia, 1987). In contrast, students with LD spend less than one minute planning in advance of writing (MacArthur & Graham, 1987). In a review of the literature, Newcomer and Barenbaum (1991) observed that students with LD have been noted to have ineffective and immature planning strategies. As a result, the compositions of students with LD are “marked by irrelevancies, redundancies, mechanical errors, early terminations, and lack of organization and coherence” (p. 587).

This study examined the effects of concept mapping, a planning strategy also known as cognitive mapping, flowcharting, semantic mapping, semantic webbing, and graphic organizers. Concept mapping is an instructional strategy used to categorize information into a graphic form, creating a visual representation of the text structure and associated personal knowledge within that display. Concept mapping may be used to activate knowledge prior to composing and to scaffold students’ memory in all phases of the writing process by assisting students to see word, concept, and category relationships. Concept mapping has been used in a variety of classroom applications for vocabulary development, reading comprehension, study skills, and prewriting organizers. Studies investigating the effects of concept mapping on academic writing have shown that students’ essays contained a greater recall of ideas and details (Draheim, 1983; Ruddell & Boyle, 1989), higher levels of organization and cohesion (Kaminski, 1993; Ruddell & Boyle, 1989), increased length (Ruddell & Boyle, 1989), improved holistic scores (Ruddell & Boyle, 1989; Zipprich, 1995), and improved end-of-grade writing test scores (Pereisich, Meadows, & Sinatra, 1990). In several of these studies (Draheim, 1983; Pereisich et al., 1990; Ruddell & Boyle, 1989; Weisberg & Balajthy, 1987), students wrote essays summarizing their reading of an expository passage. This required reading component could have a confounding effect on subsequent writing for students who struggle with comprehending and understanding text. Specifically, the quality and content of their summary essays could be negatively influenced by the need to utilize text content obtained in the reading task. The research conducted by Kaminski (1993), Schultz (1986), and Zipprich (1995) were the only identified concept mapping studies that assessed student writing free of a required expository reading task. Additional research is needed that examines the effects of concept mapping as a prewriting strategy when reading comprehension is not necessary to produce a quality written text.

Concept mapping is an instructional strategy used to categorize information into a graphic form, creating a visual representation of the text structure and associated personal knowledge . . . .

Concept maps typically have been generated using paper and pencil. However, computer software now offers students an alternative mode for producing concept maps. Inspiration™ (Inspiration Software, 1988–1993), the software program used in this study, functioned as a tool for students to create concept maps. Like hand-drawn maps, computer-generated maps are graphic representations of text structure and personal knowledge. However, this software tool allows students to move ideas around with mouse control, to easily add
and delete concepts and ideas, to color-code concepts and relationships, to use symbols to represent ideas, and to check the spelling of words used on the map. A central question of this study was to understand whether the writing produced from computer-generated maps created with a flexible software tool would be different from the writing produced from hand-drawn maps.

In this study, the concept mapping strategy was introduced using teaching techniques shown to be effective with students with LD. Strategy instruction is a teaching approach that assists students in developing strategies for all phases of the writing process and teaches self-regulation of performance of the strategies. Strategy instruction assists struggling student writers by breaking down writing tasks and making the subprocesses and skills much more explicit. A number of intervention studies have shown that students with LD can be taught to use writing strategies effectively (e.g., DeLaPaz, 1999; Graham & Harris, 1989; Graham & Harris, 1993; Graham et al., 1992; MacArthur et al., 1995). Writing strategy instruction has focused on teaching students how to set goals, engage in self-regulation, and evaluate strategy instruction has focused on teaching students how to set goals, engage in self-regulation, and evaluate their performance during the writing process. Successful interventions have heightened learner awareness of task demands, taught and modeled task-specific strategies, provided guidance and feedback, and provided opportunities to generalize skills (Seidenberg, 1988). The goal of writing strategy instruction is to assist students with developing independent skills for planning and monitoring their writing that will allow them to move beyond lower-level processes and shift their cognitive resources to the higher-level features of writing. Principles of strategy instruction were used in this study to teach concept mapping as a tool that could support students throughout the writing process.

This study investigated the effects of two forms of concept mapping, hand-drawn and computer-generated, on the descriptive essay writing of middle-level students with LD. The two forms of concept mapping, and computer-generated concept mapping, were taught using a model of strategy instruction adapted from Harris and Graham (1996). The central research question of this study was: Are there differences among the descriptive essays of middle-level students with LD produced under the writing conditions of no-mapping, hand-drawn concept mapping, and computer-generated concept mapping? Embedded in this broad question were the more specific questions of: (1) Are there differences between the essays students produce when not using mapping as a writing support and when using mapping as a writing support, regardless of whether the maps are produced by hand or on the computer? and (2) Are there differences between the essays produced when using hand-drawn maps as a writing support and those produced when using computer-generated maps as a writing support? In other words, does the use of technology as the tool for producing the map result in any differences in the written product?

**METHOD**

**Experimental Design**

A repeated measures within-subject design was used in this study with writing condition serving as the independent variable. See Table 1 for a display of the study design. To examine the efficacy of both hand- and computer-mapping, this study examined the differences among three writing conditions. These writing conditions were: (1) no-mapping, (2) hand-mapping, and (3) computer-mapping. Two baseline descriptive essays were produced by each student prior to instruction in concept mapping and composing. Students were then provided two weeks of instruction in hand-drawn and computer-generated mapping.

For comparative analysis of the writing produced under the different conditions, each student composed two

<table>
<thead>
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<th>TABLE 1</th>
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<tr>
<td><strong>Description of Study Design</strong></td>
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<tr>
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<tr>
<td><strong>Week 1</strong></td>
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<tr>
<td>All students wrote two baseline essays</td>
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</table>

*Note. Following instruction in mapping, students were diagram-balanced into three groups and composed essays under the three planning conditions. One essay was composed each week; two essays were composed under each writing condition for a total of six essays for each student.*
descriptive essays using each type of planning. Writing conditions were randomized to control for order (i.e., practice) effects. Students (n = 12) were counterbalanced into two sets of six using a diagram-balanced method (Keppel, 1991). Three writing positions resulted, with students producing two essays for a given writing condition. Following essay writing in Position 1, students were counterbalanced into the second position. Following essay writing in the second position students were rotated into the third and final position. Therefore, during the six-week measurement phase, one-third of the subjects were participating in each of the three writing conditions at a given time.

### Setting and Participants

#### Setting

This study was conducted in a middle school, English/reading classroom in a medium-sized midwestern city. The school had a population of 765 students; 89.5 percent of the students were Caucasian, 4.4 percent were African American, 2.9 percent were Asian American, 1.8 percent were Hispanic American, and 1.3 percent were Native American. Thirty-six percent of the population qualified for free or reduced lunch. This study was conducted as part of the literacy curriculum during two different class periods.

#### Student Participants

Students in this classroom were eighth-grade students identified as needing reading support. Students had an educational identification in one of the following areas: low reading ability, non-special education (n = 12), learning disabled (n = 12), or mild mentally handicapped (n = 3). Although all students in the classroom participated in the overall writing project, the 12 students whose primary disability was LD, with needs in written expression, were included in this study. Eight students were identified as both LD and speech-language impaired (SLI). Eight of the student participants were male and four were female. Nine of the students were Caucasian and three were African American. All LD participants met the following criteria for participation: (1) identified by their local school district as having a learning disability (which followed federal guidelines); (2) IQ scores between 85 and 120 on a norm-referenced intelligence test; (3) achievement that was at least two years below grade level in one or more academic areas; (4) Individual Education Plan (IEP) objectives for written expression; and (5) keyboarding skills of at least 10 words per minute (MacArthur, Schwartz, & Graham, 1991). Information regarding age of participants, typing speed, Metropolitan Achievement Test (The Psychological Corporation, 1992) scores, and Weschler Intelligence Scale for Children-III (The Psychological Corporation, 1991) scores are presented in Table 2.

### Teacher/Researcher Participants

This research project was a public school-university collaboration and the on-site research team was comprised of a special education teacher, a speech-language pathologist (SLP), and a university researcher. The special education teacher was the primary instructor during concept mapping instruction and essay writing. The SLP served as a team teacher in the classroom prior to the onset of the project and continued to serve a support role throughout the project by monitoring and supporting student writers and assisting with classroom management. The university researcher was present in the classroom on a daily basis and served as a consultant and assistant to the classroom teacher. Specifically, the university researcher demonstrated the computer software, provided technical support, monitored consistency in research procedures, and supported student writers throughout the project.

### Materials

#### Writing Prompts

The type of expository writing targeted in this study was descriptive essays. The stimuli for writing were written prompts (e.g., “Describe your dream home.”). The writing purpose, text structure, and topics were defined by the writing prompts. Prompts addressed general knowledge topics to minimize student differences in declarative knowledge. Student interest is a factor when providing writing prompts; therefore, a total of 50 prompts were rated by the student participants in this study and interest ratings (five-point scale, with 5 indicating a lot of interest) were obtained. The nine prompts with the

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**TABLE 2**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Range</th>
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<tbody>
<tr>
<td><strong>Age</strong></td>
<td>14.4</td>
<td>13.8–15.1</td>
</tr>
<tr>
<td><strong>Typing speed (words per minute)</strong></td>
<td>16.14</td>
<td>10–35</td>
</tr>
<tr>
<td><strong>Metropolitan Achievement Test (Stanine Scores)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prewriting</td>
<td>2.50</td>
<td>1–4</td>
</tr>
<tr>
<td>Composing</td>
<td>2.67</td>
<td>1–4</td>
</tr>
<tr>
<td>Editing</td>
<td>2.75</td>
<td>1–5</td>
</tr>
<tr>
<td>Reading</td>
<td>1.92</td>
<td>1–3</td>
</tr>
<tr>
<td>Language</td>
<td>2.17</td>
<td>1–4</td>
</tr>
<tr>
<td><strong>WISC-III (Standard Scores)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>82.64</td>
<td>69–94</td>
</tr>
<tr>
<td>Performance</td>
<td>99.27</td>
<td>62–123</td>
</tr>
<tr>
<td>Full scale</td>
<td>88.73</td>
<td>78–102</td>
</tr>
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</table>

Note. Scores were obtained from the school files and were based on tests that had been administered by school personnel within the previous three years.
highest average scores were used in this study (prompts are provided in Appendix A). Eight of the nine prompts were randomly selected to create a writing prompt set for each student. Sets were randomly assigned to students.

Software Tools

All essays were written using Claris Works 2.0v1 (Claris Corporation, 1992–1995) word processing software on Macintosh desktop computers. Inspiration™ (Inspiration Software 1988–1993) software was used to create computer-generated maps. Inspiration™4.0 is a prewriting software program designed to assist writers in brainstorming, mapping, and writing. Two prewriting organization choices are available: (1) diagramming (i.e., concept mapping), and (2) outlining. For this study, only the diagramming feature was taught to students. In the mapping mode, Inspiration™ functions as a tool for creating individualized concept maps. Using a menu-driven system, individuals can create symbol shapes, type text inside symbol shapes, and connect symbol shapes with arrows.

Writing Attitude Surveys

Attitude was defined as the feelings and beliefs students have about their writing ability and about written language tasks. The Writing Attitude Scale was used to assess students’ attitudes toward written language. This attitude scale consisted of 18 Likert-scale items (five-point scale) that addressed the constructs of enjoyment, ease, competence/ability, and strategy use in writing. Points on the scale ranged from 1 (strongly disagree) to 5 (strongly agree). An attitude score was obtained by summing the scores for each item and dividing by the total number of items. The score for Item 2 was deleted from the data set prior to summing the data because the wording of this item was in the opposite direction of the other items and inspection of the data revealed that responses to this item might not have been reliable.

To assess change in general writing attitude and differences in attitude toward writing under the different conditions, writing attitude surveys were given at the following points in the study: (1) after completion of the two baseline essays, (2) following the writing of essays using hand-mapping, (3) following the writing of essays using computer-mapping, and (4) following completion of all writing conditions (post-measurement). The first and last surveys assessed general attitude toward writing with items such as, “I like to write” and “It is easy for me to organize my ideas.” Following the writing of essays using mapping, the surveys were adjusted to relate to the type of mapping they had just used. Specifically, the items were identical to the general writing items, but with reference to either hand- or computer-mapping.

The data obtained from the pre-instruction general attitude survey also served as the data for the no-mapping condition for the analysis of writing attitude among conditions. For the two concept map attitude surveys, the attitude survey was identical to the no-mapping/general survey; however, each question concluded with either hand- or computer-map. For example, one hand-mapping question stated, “I like to write when I hand-map.”

Instructional Procedures

Teacher Training and Planning

The principles for concept mapping instruction were derived from research examining strategy instruction for students with learning disabilities (Englert, 1992; Graham & Harris, 1988; Graham et al., 1992; Harris & Graham, 1996; Seidenberg, 1988). The university researcher provided training meetings, resource materials, and readings that targeted the principles of strategy instruction to the classroom teacher and SLP. The classroom teacher, SLP, and the university researcher then engaged in joint preparation of the instructional plans. A checklist containing a detailed outline of the instructional sequence provided additional control for reliability in instruction. This lesson plan checklist was used as a guide for the classroom teacher during instruction. To ensure consistency in content and sequence of information, the university researcher was present to observe for treatment fidelity; adherence to all instructional components was documented. The university researcher trained the classroom teacher and SLP in the use of the Inspiration™ (Inspiration Software, 1988–1993) software.

Writing of Pre-Instruction Essays

Baseline data were obtained by having students compose two descriptive essays prior to the onset of instruction. Students were given a writing topic and told that they could take as much time as needed using their typical planning approach and to write when ready. Students composed their essays on a word processor.

Instruction for Hand-Mapping and Descriptive Essays

Hand-drawn concept mapping and its application to descriptive essays was taught during the first week of instruction in five 50-minute sessions. The classroom teacher told the students that they would be learning about descriptive essays and that they would be learning a strategy that would help make writing
Strategies could be numbered as a reminder of the descriptive essays. To help students organize information, paragraphs, and sentences within paragraphs, for categorizing and details could be sequenced into this process the classroom teacher discussed how critical ideas to be placed on the concept map. During the concept mapping, students assisted by generating forms and explaining that this involved choosing the classroom teacher modeled use of telegraphic language. Subtopics referred to as topic categories, were generated together idea and circled it. This topic was labeled as the classroom teacher wrote it on an overhead projector. Once the group agreed on a topic, for the activity. The classroom teacher led a discussion with students about the significance and benefits of using the concept mapping strategy. Students were asked two questions: (1) How do you think this strategy might help you write? and (2) How could this strategy help you with different types of writing (e.g., letters, reports, and descriptive writing)? To reinforce student participation as collaborators in the learning process, goals and purposes that students generated were posted on a chart in the classroom.

Discussion of goals and purposes. The classroom teacher led a discussion with students about the significance and benefits of using the concept mapping strategy. Students were asked two questions: (1) How do you think this strategy might help you write? and (2) How could this strategy help you with different types of writing (e.g., letters, reports, and descriptive writing)?

Modeling the strategy. The classroom teacher modeled use of the concept mapping strategy by creating a map while “thinking out loud” together with the students. Students were offered several topics to select from for the activity. Once the group agreed on a topic, the classroom teacher wrote it on an overhead projector and circled it. This topic was labeled as the “main idea” of the concept map. Next, possible subtopics, also referred to as topic categories, were generated together as a large group. The classroom teacher demonstrated use of arrows to connect main ideas and subtopics. Finally, details were generated and added to each of the subtopics. Students participated in the entire process by brainstorming possible categories and details.

Concept mapping requires information to be written in small spaces, and students were taught how to write subtopic information in telegraphic form. The classroom teacher modeled use of telegraphic language forms and explained that this involves choosing the most important information. Sentences were generated together as a group and were reduced to key words for the concept map. Students assisted by generating critical ideas to be placed on the concept map. During this process the classroom teacher discussed how the categories and the details could be sequenced into paragraphs, and sentences within paragraphs, for descriptive essays. To help students organize information, the classroom teacher illustrated how subtopic information could be numbered as a reminder of the sequence of concepts when composing. Students collectively made decisions about the sequence of subtopics, which were then numbered on the concept map. The classroom teacher explained that each number would represent a different paragraph in their descriptive essays. As the teacher modeled the steps for generating a concept map, a set of “Questions to Ask Yourself About Mapping” was introduced and shared with the students as a handout. Students were told that these steps would serve as a reminder about what to ask themselves when they were creating their concept maps. See Appendix B for “Questions to Ask Yourself About Mapping.”

Upon completion of the map, the classroom teacher continued to use a “think aloud” strategy to model the transfer of subtopic information from the map into written form in a descriptive essay. Instruction followed the sequence of procedures for transferring concept maps into written paragraphs that were adapted from Heimlich and Pittelman (1986). Starting with top-level structures (i.e., topics and subtopics), the classroom teacher reviewed the information on the map. Each category was reviewed, including the main ideas and supporting details. The classroom teacher modeled how she would rewrite the information from the map into complete sentences. Students participated by generating the sentences for the written description, and the classroom teacher wrote each sentence on an overhead. Using the main topic, an introductory sentence and paragraph was written. For each subtopic category, a topic sentence was written, followed by supporting sentences. Finally, the idea of a concluding paragraph was explained, discussed with the group, and together with the students, the teacher wrote the concluding paragraph. As the teacher modeled the steps for transferring map information into a descriptive essay, a set of “Questions to Ask Yourself About Writing” was introduced and shared with the students as a handout. Students were told that these steps would serve as a reminder about what to ask themselves when they were transferring concept-map information into an essay. See Appendix B for “Questions to Ask Yourself About Writing.”

Student mastery of strategy steps. During the stage focusing on mastery of strategy steps, students rehearsed and memorized the sequence of activities for concept map construction. Students rehearsed and practiced the steps in both large and small groups. The “Questions to Ask Yourself About Mapping and Writing” were posted for easy reference.

Guided practice and feedback. During guided practice sessions, the research team scaffolded student performance and provided feedback. In small groups, students chose a second descriptive writing topic and created a second hand-drawn map. Each classroom session began with a review of the purposes for concept mapping and the sequence for constructing a map. Using the concept mapping steps posted on the board as
a guide, students then worked together in small groups and jointly constructed a hand-drawn concept map. Students used the concept maps created in small groups to compose independent descriptive essays on a word processor. To assist with application of the strategy, researchers prompted students to use the “Questions to Ask Yourself About Mapping and Writing” as a guide.

Instruction in Computer-Mapping and Descriptive Essays

During the second week of instruction, students participated in five 50-minute classroom sessions that provided instruction and training in the Inspiration™ 4.0 program (Inspiration Software, 1988–1993). The Inspiration™ training period emphasized not only technical proficiency on the software but also provided additional practice with concept mapping and its application to writing. To ensure consistency, all concept mapping and writing instruction was taught by the classroom teacher. The university researcher demonstrated the technical features of the program.

Instruction for using computer-generated maps employed the same sequence of strategy instruction steps as when teaching hand-maps—strategy description, discussion of goals and purposes, modeling of the strategy, student mastery of strategy steps, and guided practice and feedback. The teacher continued to refer to the “Questions to Ask Yourself About Mapping and Writing” throughout the computer-mapping instructional sequence. Concept mapping and its application to descriptive essays was reinforced through training on Inspiration™ (Inspiration Software, 1988–1993) software by repeating the methods described above in the hand-mapping instruction. In the first lesson, the classroom teacher told students that they were going to continue learning about descriptive essays and that they would be learning how to create their concept maps on the computer. Specific Inspiration™ features were demonstrated in the technical instruction (e.g., creating a topic bubble, adding symbol shapes, and linking ideas). As each software feature was illustrated, the classroom teacher discussed how these features matched the steps used in the concept mapping instructional sequence from the previous week.

Upon completion of the demonstration, students were paired at computers to learn the software features through hands-on participation. Each pair independently explored the features of the Inspiration™ software and practiced creating the components of computer-generated concept maps (e.g., creating bubbles, entering text, moving bubbles, numbering). After practicing the use of Inspiration™, paired students chose a topic to practice computer-mapping. Students printed paper copies of their maps, which were then used to compose independent descriptive essays on a word processor. When creating the maps and descriptive essays, students were prompted to use the “Questions to Ask Yourself About Mapping and Writing” as a guide. The individual concept maps were placed on the table next to the computer as students composed. The support team was available to answer questions and provide positive and corrective feedback.

Students were assessed to determine if they could operate Inspiration™ (Inspiration Software, 1988–1993) software independently. This skill was assessed using a “check-out” system developed by the university researcher and was conducted with each student individually. The check-out system identified key features of the software tool that were needed to create concept maps. Students demonstrated each software feature, and the researcher rated student performance on the following scale: 1 = full assistance, 2 = partial assistance, and 3 = no external assistance. All students operated basic Inspiration™ features without external assistance (mean score = 3).

Data Collection

As described above, students composed two baseline descriptive essays prior to the onset of concept mapping instruction. Instruction in mapping occurred for two weeks as described above. During the final days of instruction, the researchers anecdotaly noted each student’s ability to use the mapping strategy with available prompts. Final essays were written when each student demonstrated the ability to create maps and write from their maps with the prompts. Following instruction in mapping, one essay was written by each student every four to six school days for six weeks. Students wrote two essays using each of the planning strategies, for a total of six essays. See Table 1 for a description of order of writing conditions.

Students took as much time as they needed to plan and compose each essay. Students could choose to work on other activities and return to their writing project at any time. When given each writing prompt, students were told which mode of planning and writing to use. Students writing in the hand-mapping and computer-mapping conditions were told that they would be planning their writing using a hand-drawn or computer-generated concept map. Students were told they could use the “Questions to Ask Yourself” as a reminder about the steps for mapping and composing. Students in the no-mapping condition were told that they could take as much time as needed to think about their writing topic and when they were ready, to write using their typical approach. Upon completion of their writing project for the week, students engaged in other classroom curricula (e.g., independent reading and follow-up text summaries).

Writing attitude information was obtained from students at four different times. Following the completion of the baseline descriptive essays, all students were administered the survey that examined general writing attitude. When each student completed their two-week rotation in the hand- or computer-mapping condition,
they completed the survey targeting their attitude toward writing with the planning strategy they had just used. At the completion of the project, all students again completed the general writing attitude survey.

**Scoring Procedures**

The analysis of the descriptive essays was based on final drafts of the students’ writing products. Tabulation of the quantitative measures was conducted through the use of Child Language Analysis (CLAN) software (MacWhinney, 1991).

**Number of Words**

Number of words, sometimes referred to as fluency, was measured to examine the length of descriptive essays across conditions (Isaacson, 1985). Number of words was obtained by counting the total words written on the final product.

**Syntactic Maturity**

Syntactic maturity was measured to examine the linguistic length and complexity of written utterances. Assessment of syntactic maturity measures “the degree to which a student uses expanded, more complex sentences” (Isaacson, 1985, p. 410). Mean Length of Utterance in words was used as the index of syntactic complexity of students’ written language (Brown, 1973). The examination of syntactic complexity of utterances was made possible through division of written phrases into “minimal terminable units” (T-units) (Hunt, 1965, 1970). T-units were defined by Hunt (1965) as “one main clause plus all the subordinate clauses attached to or embedded within it” (p. 20). Clauses beginning with “because” were considered subordinate and remained attached to the related T-unit. T-units are considered to be a valid measure of written complexity (Loban, 1963) and are sensitive to patterns of development, or at least change in written complexity. It has been confirmed repeatedly that T-units are a better predictor of grade levels than any other measure of written complexity (Hillocks, 1986).

In the current study, sentence fragments were observed to occur in some of the writing samples; consequently, special rules for T-unit scoring were developed that would address this particular phenomenon. To address the scoring of sentence fragments, utterances were divided based on a combination of T-unit and C-unit rules. The C-unit (Loban, 1976), which was developed to measure syntactic complexity of oral language, is essentially identical to the T-unit. However, it takes into account the elliptical utterances used in conversational language. A C-unit includes units that do not have clausal status (Scott, 1988) but, from a conversational perspective, can stand alone in meaning. In the current study, students’ written utterances that did not have clausal status, but were considered to communicate a complete thought, were retained as an utterance. Specifically, when clausal status was not met, the students’ use of beginning capitalization and terminal punctuation indicated a complete thought and counted as one T-unit.

Using the rules for T-unit division described above, the researcher divided students’ descriptive essays into T-units. For the CLAN analysis of quantitative measures, the researcher prepared individual student documents using CLAN conventions. Each written description was entered into the CLAN (MacWhinney, 1991) software program, and the number of words, number of T-units, and syntactic complexity (words per T-unit) in the descriptive essays were computed.

To establish the reliability for the quantitative analysis of the writing samples, 25 percent of the descriptive essays from each writing condition were randomly selected for rescoring. A second rater independently divided the writing into T-units and entered these story samples into CLAN. The interrater reliability for number of words, number of T-units, and T-unit division was 99.5 percent, 99.8 percent, and 99.3 percent agreement, respectively.

**Number of T-Units**

Number of T-units was examined as a second measure of language quantity. Number of written T-units was computed as the mean number of T-units produced by each student under each writing condition.

**Holistic Writing Scores (Writing Quality)**

A holistic analytic scale developed by Shell, Murphy, and Bruning (1989) was adapted and used to measure the overall quality of the descriptive essays. This scale was based on analytic scoring methods described by Cooper (1977). Items on this scale were consistent with the mode of composition (i.e., descriptive essays) used in this study. The scoring categories of the scale included: realization, clarity/quality, organization, quantity/density, and language mechanics. Scores of 0, 1, 2, or 3 were assigned for each category, with 0 representing the lowest quality and 3 the highest. A score total was derived by summing the five category scores (total score range 0–15).

Holistic ratings were derived from quick, impressionistic judgments about a writing sample (Charney, 1984), with no more than two minutes spent rating any given writing sample. The university researcher and a second rater independently rated the descriptive essays using the holistic measure. Raters were trained with sample papers using the scoring method until interrater reliabilities between the two raters exceeded a Pearson $r$ correlation of 0.80. To ensure greater reliability, the two raters independently rated the complete set of 192
descriptive essays. Score reliability was obtained by calculating Pearson correlation coefficients for the holistic scores of the two raters. The correlation between the holistic scores of the two raters for all subjects was 0.75. The commonly obtained interrater reliability estimate for holistic essay scoring ranges from a correlation of 0.68 to 0.89 (White, 1985); therefore, the interrater reliability obtained in the current study was considered to be adequate and consistent with previous research. The quality scores used in the final analysis were obtained by averaging the scores of the two raters. As a final step to ensure interrater reliability, the two raters juried on holistic scores that were greater than one-point difference within a category and greater than a two-point difference within the holistic score total. For these samples, the juried score rather than the average was used in the analysis.

DATA ANALYSIS AND RESULTS

Effects of Writing Condition

Separate repeated measures one-way analyses of variance (ANOVA) were performed for each quantitative variable (i.e., means of two essays under each condition for number of words, number of T-units, syntactic complexity) and quality variable (i.e., holistic mean scores) to test for overall differences among modes of writing for baseline, no-mapping, hand-mapping, and computer-mapping conditions (α < 0.05). The Tukey pairwise mean comparisons revealed that number of words in the no-mapping, hand-mapping, and computer-mapping conditions were significantly greater than the number of words in the baseline writing condition.

Syntactic Complexity (T-Unit)

There were no significant main effects for mean-length of utterance (T-unit), F (11, 3) = 0.65, p < 0.59. Specifically, there were no significant differences among conditions in syntactic complexity as measured by number of words per T-unit.

Number of T-Units

Significant main effects were found for number of T-units, F (11, 3) = 6.05, p < 0.01. The Tukey pairwise mean comparisons showed that students produced significantly more T-units when writing in the no-mapping, hand-mapping, and computer-mapping conditions than when writing in the baseline condition.

Holistic Writing Scores (Writing Quality)

In the ANOVA for writing quality, a significant main effect was found, F (11, 3) = 7.56, p < 0.01. Results of the Tukey pairwise mean comparisons revealed that mean holistic scores were significantly greater for no-mapping, hand-mapping, and computer-mapping conditions than for the baseline condition.

General Writing Attitude

In the analysis for general writing attitude pre-instruction and post-measurement of all writing conditions, there were no significant main effects, F (1, 11) = 4.46, p < 0.06. The means and standard deviations for attitude pre-instruction and post-measurement are presented in Table 4.
**Writing Attitude Among Writing Conditions**

A significant main effect was found for writing attitude at $F(2, 11) = 8.90, p < 0.01$. Attitude toward writing was significantly more positive when computer-mapping than when compared to the other conditions (see Table 4).

**Change in Performance Over Time**

Visual inspection of results under the baseline, no-mapping, hand-mapping, and computer-mapping conditions revealed a similar trend in mean scores across time. Specifically, students improved their mean scores for the number of words, number of T-units, and holistic scores across time regardless of condition. The examination of data, described below, explores the pattern of scores, within each condition, across the time of writing measurement.

**No-Mapping**

Inspection of the mean number of words for the no-mapping condition indicated a positive increase in total output per writing sample across baseline (70.04), Position 1 (110), Position 2 (123.25), and Position 3 (177.38). This pattern, as reflected in the mean scores, also was present for the number of T-units and mean holistic scores (see Table 5).

**Hand-Mapping**

Examination of the mean number of words for the hand-mapping condition indicates a positive increase in total output per writing sample across baseline (70.04), Position 1 (113.5), Position 2 (122.88), and Position 3 (140.75). For the number of T-units, an increase occurred from baseline (6.70) to the first position (10.38) and remained consistent into the second position (10.38). An increase in number of T-units occurred again in the final position (16.50). For the holistic writing scores, there was an increase from baseline (4.44) to the first position (7.06), a slight decrease in the second position (5.88), and a small increase again in the third position (6.56). The mean holistic score following instruction was greater than the mean score in baseline (see Table 5).

**Computer-Mapping**

Inspection of the mean number of words for the computer-mapping condition indicated a positive increase in total output per writing sample across baseline (70.04), Position 1 (93.25), Position 2 (138.38), and Position 3 (158.88). This pattern also was present for the number of T-units and mean holistic scores (see Table 5).

**Summary of Learning Effects Across Time of Intervention**

An increase in mean scores over time for both quantitative (i.e., number of words and number of T-units) and qualitative (i.e., holistic writing scores) writing measures was observed in all conditions. It is likely that this positive trend reflects the learning effects across time. Students’ improvement under all conditions is likely due to the instruction they received, regardless of condition, about writing and what good writers do before, during, and after writing. Average holistic scores for individual students by position of writing condition (Table 6) provides evidence that, in general, students’
writing quality was improving over time regardless of the writing conditions. As indicated by the asterisks on the table, seven of the nine participants who had their highest mean quality score when writing using no-mapping, produced those essays in the second or final position.

DISCUSSION

The primary purpose of this study was to determine whether the use of mapping, either hand-drawn or computer-generated, would have a positive effect on the writing of middle school students with LD. The results revealed that students using maps did make improvements in several aspects of their writing when using both types of mapping as a prewriting strategy. However, the results of the current study were not clearly in favor of concept mapping, as students in all three writing conditions (i.e., no-mapping, hand-mapping, and computer-mapping) wrote longer and better essays than they did prior to mapping instruction. This discussion explores possible explanations for both patterns of results.

Why Did Students Write MORE?

When using either form of concept mapping, students wrote more, as measured in number of words and number of T-units, than they did prior to instruction in mapping. These results are consistent with earlier research examining the effects of concept mapping on the writing of various student populations (i.e., fourth graders, fifth graders, and college freshman). Specifically, when students used concept mapping prior to writing summaries of expository text, their writing included a greater number of propositions (Reutzel, 1986), main ideas (Alvermann, Boothby, & Wolfe, 1984), idea units (Boothby & Alvermann, 1984; Draheim, 1983), and details (Ruddell & Boyle, 1989) than when concept mapping was not used. Ruddell and Boyle (1989) found that the participants in the two mapping groups of their study wrote longer essays than the no-mapping control group. The participants in the current study also wrote longer essays after training in mapping; however, this effect was found when students wrote without mapping as well. The subsequent paragraph provides one possible explanation for the increases seen in the amount of writing students produced under all conditions.

Prior to intervention, the writing of many of the students with LD in the current study often exhibited a form of “dump” writing. In other words, they “dumped” all the information they had in their heads, without consideration for how it came out. When students finished writing the easily accessible thoughts, they tended to consider themselves “done.” Embedded in the instruction on hand- and computer-mapping were a number of questions that prompted students to add ideas and to expand on the ideas already generated (see Appendix B). Students were encouraged to use these questions as they put down their ideas for the concept map and when they were converting their maps into an essay. The constant questioning of students and the encouragement to expand ideas may have affected the amount of writing students produced under all writing conditions. Specifically, rather than “dumping” and being “done,” students knew that good writers described, elaborated, clarified, and explained relationships between ideas. Teaching students to think about these issues while writing may have led to longer essays regardless of the prewriting strategy employed.

Why Did Students Write BETTER?

Following training in hand- and computer-mapping, students with LD in the current study also made significant increases in the quality of their writing as measured with a holistic writing score. These positive effects on writing quality are similar to the effects found in other research that has shown concept mapping, when used as a prewriting strategy, to produce higher levels of text organization for typically developing students (Kaminski, 1993) and significant gains in the quality of writing for middle-level students with LD (Zipprich, 1995). In addition, when concept mapping has been used as a post-reading, text summary writing strategy, several factors related to writing quality have shown improvement; specifically, increased cohesion (Robinson & Kiewra, 1995; Ruddell & Boyle, 1989) and improved holistic writing and writing summary scores (Reynolds & Hart, 1990; Ruddell & Boyle, 1989).

Following the project, some students shared their thoughts with the university researcher. These thoughts, although not part of the data analyzed, were recorded anecdotally and offer additional support for the conclusions drawn from the data. For example, Chris (pseudonym), clearly expressed how mapping helped him to self-regulate the writing process. In his words, “It was better to use the maps than trying to use my brain without anything really in front of me. . . . It was like someone else was there with me, helping—tagging along and giving me ideas.”

The lack of main effects and pairwise differences found for syntactic maturity provides an interesting insight into the aspects of writing supported and not supported by mapping. In general, students wrote more (i.e., they generated a greater number of T-units) and better (i.e., they achieved higher holistic scores) when using mapping to plan. However, the lack of syntactic maturity differences indicates that mapping did not increase the sophistication of language within sentences. In other words, mapping helped students generate and organize ideas but did not increase the complexity of their sentence structures.
"It was like someone else was there with me, helping—tagging along and giving me ideas."

—Chris

In the current study, it is not possible to credit the mapping strategy alone for the improvement in writing quality, given that students also showed quality improvements when writing without the use of mapping. This change in writing quality also may have resulted from information about writing processes and conventions that was embedded in the initial writing instruction (which included both mapping and general writing strategies). As part of the instruction on both hand- and computer-mapping, students were explicitly taught how to organize their maps into “bubbles” of ideas that would represent paragraphs. Students also reviewed the concepts of introductory sentences, topic sentences, closing sentences, and sentences that explain relationships between ideas. Students were taught to organize the information on their maps into logically organized paragraphs that included these elements. For some students, the instruction or review of these writing components may have resulted in increased use of these conventions. Given the similar quality scores across writing conditions, there is a strong indication that the information and support about good writing, even though it was embedded in the instruction about mapping, may have led to better writing when writing under all three conditions.

The Potential Role of Strategy Instruction and Practice

It was anticipated that students’ writing without the use of mapping would be similar to the writing they produced prior to instruction in mapping. It also was anticipated that, following mapping instruction, differences would be found between the writing students produced when using mapping and when not using mapping. Since the writing produced following instruction in the no-mapping condition did improve from the baseline writing and did not differ significantly from writing in hand- and computer-mapping conditions on all writing variables, alternative explanations for these results must be explored. The previous sections discussed the increases in length and quality as a result of the information about writing embedded in the instruction. Another possible explanation for writing improvement is that strategy instruction and additional practice in writing, regardless of the condition, may have led to more and better writing. Visual inspection of the counterbalanced writing conditions across time (see Table 5) provides evidence of this learning effect. Specifically, number of words and number of T-units increased across time (i.e., from baseline to Position 1, to Position 2, to Position 3) for all three writing conditions, and holistic scores increased across time for no-mapping and computer-mapping.

The increases in scores from baseline to each subsequent position across time in all conditions provides evidence that students had acquired additional knowledge about writing during the initial instruction and, with each opportunity to practice, they applied what they had learned to their writing in an increasingly productive manner, regardless of condition. Given that the instructional model employed in this study was based on effective strategy instruction research (DeLaPaz, 1999; Graham & Harris, 1989, 1993; Graham et al., 1992; MacArthur et al., 1995), this should not be a surprise. Over the instructional period of two weeks, the mapping strategy was described, its purposes were discussed, it was modeled, and students had to demonstrate mastery of the strategy steps. Included in these first steps of mapping instruction were discussions about writing, what good writers do, and a review of strategies for generating and organizing ideas for writing. After instruction in mapping, students wrote additional essays for guided and independent practice using both hand- and computer-mapping. During this practice time, the research team provided feedback on the mapping process, but also prompted and supported the writing strategies that had been embedded in the instruction. The series of “Questions to Ask Yourself” for both the planning and composing phases were posted in the classroom. Students may have used these reminders to apply principles of what good writers do each time they wrote a practice essay. Then, when it came time to write the post-instruction essays, students may have been more effective in applying their learning with each additional opportunity to write.

Examination of writing quality scores for individual students (see Table 6) provides additional evidence of this possibility. Nine of the 12 students received their highest quality score in the no-mapping condition. Of those nine, seven students received this score in the second or third position. The three students who received the highest quality scores in hand- or computer-mapping also received these scores in the second or third position. The possibility that the no-mapping condition effects are an artifact of mapping instruction also can be supported by research on process writing approaches and by concept mapping studies. Several studies (Idol, 1987; Goldstein & Carr, 1996; Pereisich et al., 1990) have demonstrated positive outcomes and generalization across other writing curricula as a result of concept mapping. However, given the inconclusive nature of these results, which is due to the embedding of knowledge about writing into the instruction on mapping, additional research is needed. More information is needed that explains the subprocesses that are involved in concept mapping as a support to writing and the potential effects of mapping instruction on other writing tasks.
Attitudes Toward Mapping and Writing

Another outcome of this study in favor of computer-mapping was that students’ attitudes toward writing were significantly more positive when using computer-mapping than when writing in other conditions. Other indications that writing attitude had been impacted occurred when students chose writing with computer-mapping over other literacy tasks in the classroom and following the conclusion of the project, several students requested an additional writing prompt to compose another essay. For many students with learning challenges, the support of technology to complete a task may actually relieve some of the cognitive load; for others it may just add to the enjoyment of the activity. Attitude can have a strong impact on whether students engage actively and positively in tasks they find challenging. For reluctant writers, a positive change in attitude toward writing, regardless of the reason, could be the first step toward improved writing skills.

... students’ attitudes toward writing were significantly more positive when using computer-mapping than when writing in other conditions.

In comparing pre- and post-attitude toward writing, it should be noted that although the difference was not statistically significant, nine of the 12 students had a higher attitude toward writing in general following this project. The test for significance was conservative and just missed conventional significance ($p < 0.06$). In addition, analysis of effect size revealed that the mean difference divided by the pretest standard deviation $= 0.98$. Because an effect size of 1 is considered large, it is possible that a larger sample size may have resulted in significant differences pre- and post-measurement. This positive change is worthy of consideration and future research. These results provide preliminary evidence that when students are taught the mapping strategy to use with their writing, their positive attitude about writing increases, even on occasions when the strategy is not being used. Our observations of students was consistent with this. When the students had a better idea of how to go about a writing task, they were more positive about the task.

One student, Chris, described above and represented as Student 10 on Table 6, was a student whose overall attitude toward writing improved. His attitude toward writing on the writing attitude survey increased from 1.44 pre-instruction to 4.44 at the conclusion of the project. It appeared that writing in general became a more positive experience for Chris as a result of his engagement in the project. In addition, Chris’ overall quality of writing improved following instruction, with his highest quality score obtained with computer-mapping. This is consistent with his clear preference for computer-mapping (4.78) over hand-mapping (1.00) on his attitude survey. Chris expressed his thoughts about computer-mapping in the following statement, “It was easier to get my ideas off of the computer-maps … cause the computer-maps are easier to read than hand-maps … cause some of my hand-map writing really sucked. So I couldn’t really read much of it, but when I did computer-mapping, it really helped out cause I could easily read my writing in the computer-mapping and get it on the computer to type.”

Several students clearly preferred computer-mapping to hand-mapping. One student went so far as to use a ruler to fastidiously draw boxes for her hand-drawn maps. She was uncomfortable with the lack of orderliness of just drawing boxes or “bubbles” after she had seen what the computer could do. The thoughts expressed by some students about hand-mapping are indications of the challenges and frustrations they faced. Comments included:

- It’s hard to get everything you need how you want it to be.
- You get tired of writing all the time.
- You write them quickly and so sloppy.
- It just confused me, like my ideas are spread around the sheet and I don’t remember what order I have them.

Interestingly, many of these comments also described the writing many students produced prior to instruction in mapping; specifically, brief, sloppy, and disorganized, with multiple unrelated ideas packed into one paragraph.

Another student, Bess (pseudonym; Student 2 in Table 6), made gains in her writing, but she did not attribute her progress to the mapping strategy. Even though Bess expressed extreme dislike for mapping on the first day of the project, indicating how “stupid” it was, she demonstrated higher quality of writing in both the hand- and computer-mapping conditions compared to no mapping. Her attitude score of 2.97 for computer mapping at the end of the project compared to the no-mapping attitude score of 3.03 may actually represent a positive gain in her thoughts about mapping. In the post-project interview, Bess’ change of attitude was reflected in the statement, “It was fun … doing it on the computer … I don’t criticize it anymore, like I used to, like ‘this is stupid.’ I don’t do that no more, cause it helps some other people.” Bess was not convinced that mapping was helping her, but she did concede it might be helpful for others. Bess’ beliefs may be representative of students with LD who do not have accurate self-perceptions about themselves as writers (Sawyer, Graham, & Harris, 1992). As students like Bess learn strategies that impact their writing, it is important to help them see the connections between strategy use and improved writing.
Implications for Instruction and Future Research

Although educators often suggest concept mapping as a prewriting strategy, research in this area has been limited (Kaminski, 1993; Schultz, 1986; Zipprich, 1995). Results of this study offer preliminary evidence demonstrating positive effects of strategy instruction paired with concept mapping as a prewriting strategy for students with LD. Students’ essays in both the hand- and computer-mapping conditions demonstrated quantitative and qualitative increases above the baseline condition. The learning effects that also occurred in the no-mapping condition do not allow for firm conclusions to be made about concept mapping alone. However, this positive activity across writing measures in all conditions is potentially good news for LD students who struggle with organization and generation of writing products.

A within-subjects repeated measures design was chosen for this study for a number of reasons: (1) due to the heterogeneity of the LD student population, (2) due to the logistical factors involved in doing classroom-based research, and (3) because the learning effects in the no-mapping condition were not anticipated. Future research is needed that will more clearly demonstrate the effects of strategy instruction paired with hand- or computer-mapping. Although a between-subjects design, comparing the two mapping strategies to a control group, would provide clearer evidence, population heterogeneity and classroom-based factors may make this design difficult to implement. Rather, future research employing single-subject designs may be warranted to test the effects of mapping as a prewriting strategy and to gain more refined information about selective features of concept mapping as a writing support.

Students with language and literacy learning needs often lack strategies for approaching the writing task. As students enter into the secondary grades, where the demands for composing increasingly complex writing tasks are increased, the potential for academic failure also increases. The concept mapping strategy may be an especially useful tool for these students as it can be adapted for a variety of text structures and academic curricula. A promising outcome of this research project was seen in the students’ attitude toward writing when participating in the computer-mapping strategy. The students’ more positive view of writing and of themselves as writers may serve as a step that fosters improvements in writing quantity and quality in a range of composing tasks. However, much additional research is needed to better understand how this strategy can support students with writing difficulties and how its effectiveness varies with different forms of writing.

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REFERENCES


**APPENDIX A—DESCRIPTIVE ESSAY**

**WRITING PROMPTS**

1. Describe where you would go if you had the chance to take one trip in a time machine.

2. Describe your dream home. You can spend all the money you want.
3. Describe the worst teacher you’ve ever had.
4. If you were the principal of your school, describe how would you change it.
5. Describe what you would do if you could skip school and do anything you wanted for a day.
6. If you could be anything you want 10 years from now, what would you be doing?
7. If you were stranded on a desert island, describe what and who you would want with you.
8. If you could be doing anything the night you turn 21, what would you like to be doing?
9. Describe what you would do if you had a million dollars.

APPENDIX B—QUESTIONS TO ASK YOURSELF ABOUT MAPPING AND WRITING

Questions to Ask Yourself About Mapping

1. What do I know? Do I have any personal experience that relates to this?
2. Do I know anything else? Brainstorm and add details.
3. Can I think of a related idea?
4. Did I connect my related information with arrows?
5. What order should I put my ideas in?
6. Do I like where I put the information (does it make sense)?
7. Review the map—am I ready to turn it into paragraphs?
8. Have I thought of everything? If yes, you’re ready to write.
9. Remember to post your map next to the computer.

Questions to Ask Yourself About Writing

1. Did I start with an introductory sentence?
2. Do my paragraphs have topic sentences?
3. Have I written what I know?
4. Did I describe it completely?
5. Did I add all the details I could think of?
6. Did I explain “why”?
7. Did I describe any feelings?
8. Did I add any related ideas?
9. Did I include a closing sentence?

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