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Spinning Straw into Gold: Transforming Information into Knowledge during Web-Based Research

Concerned by an "alarming number of students [who] unwittingly plagiarize" on research projects, Kathleen Guinee and Maya B. Eagleton developed a strategic notetaking strategy called CHoMP. Results with students of varied abilities and in various grades show that students can learn to evaluate sources for significant information and correctly paraphrase what they find.

Modern computer and Internet technologies have changed the methods for conducting research. Today's middle school and high school students have resources and tools at their fingertips that were not available a generation ago. Through email, students can contact experts as primary sources, and with the World Wide Web they can retrieve countless primary and secondary sources reflecting majority and minority viewpoints. Personal computers have also increased students' options for presenting the fruits of their research through desktop publishing, slide shows, and Web sites. Despite these technological advances, the objectives of teaching students to conduct quality research and demonstrate what they have learned have remained the same from one generation to the next. In fact, teaching some traditional concepts has become even more important. For example, computer shortcuts such as cut and paste have made unwitting plagiarism easier, reinforcing the need to teach students the difference between paraphrasing and plagiarizing.

Using this approach, students transform information they have read into their own words, creating paraphrased notes they can use later to re-present the research content without plagiarizing.

Over the past five years in our roles as teachers and educational researchers, we have observed almost two hundred upper elementary, middle school, and high school students from three states conducting Web-based research (see Eagleton, Guinee, and Langlais; Guinee, Eagleton, and Hall). During this time, we have witnessed an alarming number of students unwittingly plagiarize large portions of their final research products. This is a concern not only because plagiarism is wrong but also because an optimal way for students to demonstrate that they have synthesized the material they have found is to re-present the information in their own words. If students plagiarize, they have either avoided internalizing the research content or are forfeiting the credit they deserve for their efforts.

Sir Francis Bacon said, many generations ago, that "knowledge is power." In today's information-rich environment, D. N. Perkins reminds us that knowledge is not equivalent to information; rather, knowledge must be created or designed by each individual. Like spinning straw into gold, students who can convert information into useful knowledge and then share it with others are well on their way to success in school and life (Leu et al. 1576). Synthesizing and summarizing are among the most difficult strategies for students to learn (Harvey and Goudvis 143); therefore, it is critical to teach these essential skills.

We propose that one solution for teaching students to transform information into knowledge is to teach them to make notes strategically. Maya has designed curricula for teaching the concepts and skills necessary for conducting print-based and Web-based research (see Eagleton and Dobler) and has piloted these interventions in several middle school and high school classrooms. In this article,

FIGURE 1. Description of the Classes Discussed in this Article

Grade	Number of Students	Classroom Context	Research Task	State	Year
Eighth	38	Two English language arts inclusion classes	Six-week project about heroes	MA	2001–02
Ninth	6	One special education English class	Two multiweek projects about sports and cars	AZ	2002–03
Seventh	6	One self-contained special education class	Two multiweek projects about animals and famous people	AZ	2003–04
Fifth	16	One regular education class	Two class-period-length assignments (e.g., pet care)	NJ	2004

we focus on students' notemaking strategies during Web-based research, presenting observations from our research experiences (see fig. 1) and a description of Maya's classroom-tested notemaking strategy called *CHoMP.*

The Problem: Pervasive Plagiarism

Students generally have good intentions not to plagiarize, but some find plagiarism difficult to avoid. For example, when questioned, all sixteen students in the fifth-grade class reported that they had used their own words to write their research reports. The students were acutely aware that plagiarism is wrong; as one fifth grader noted, "I wrote my own words because it is illegal to copy word from word." However, more than a quarter of these students plagiarized extensively in their written research reports, copying over 75 percent of their content from their Web sources.

Our older students had similar difficulties. For instance, all six of our seventh graders produced initial research projects (before CHoMP) that contained extensive plagiarism. The seventh graders' products resembled their Web sources in three ways. Some final products contained whole paragraphs copied verbatim, while others contained sentences copied verbatim but presented in a different order from the source. The most "original" final products were a compilation of sentence excerpts from the source. Figure 2 contains an excerpt of one seventh graders' report about the platypus, which demonstrates this approach.

As these examples clearly illustrate, students are in need of strategies that lead to paraphrasing instead of plagiarizing. The notemaking phase is an opportune time for students to begin converting collected facts and ideas into their own words.

FIGURE 2. Example of a Seventh-Grader's Research Product before CHoMP

Source	Excerpt
Student Research Product	It's a small, aquatic, egg-laying mammal with webbed feet, a tail like a beaver's, and a horny beak resembling the bill of a duck. It has a thick covering of waterproof hair. The bill is a blue-gray, blackish color, and the lower bill is smaller than the upper bill.
Web Source 1	A small, aquatic, egg-laying monotreme mammal (*Ornithorhynchus anatinus*), with webbed feet, a tail like a beaver's, and a horny beak resembling the bill of a duck: in full duckbill platypus. From: http://www.rentcomputers.com/platwhat.html
Web Source 2	The platypus has a thick covering of waterproof hair all over its body except for the feet and bill. . . . The platypus's sensitive, pliable bill is a blue-gray, blackish color with the two nostril holes near the tip. . . . The lower bill is smaller than the upper bill. From: http://www.matmice.com/home/platyappearance

The Approach: Strategic Notemaking

The CHoMP notemaking strategy teaches students to paraphrase important information early in the research process. Using this approach, students transform information they have read into their own words, creating paraphrased notes they can use later to represent the research content without plagiarizing. This notemaking strategy also addresses an instructional focus identified by our classroom teachers. The eighth-grade language arts teacher told us that one of the most difficult parts of the research process for her students is "how to extract the key points that they need" from information. CHoMP was developed to address these core research concepts of extracting and paraphrasing important information based on our analyses of students' research practices and a synthesis of the literature on summarization (e.g., Brown and Day; Hare and Borchardt; Winograd).

The verb *chomp* serves as an apt metaphor for the notion that notemaking involves selectively biting off small pieces of information. With CHoMP, students learn to do the following:

- Cross out small words, such as prepositions and conjunctions
- Highlight important information in the remaining text
- Make notes based on the highlighted information by abbreviating, truncating, making lists, using symbols, and drawing instead of writing full sentences
- Put the notes in their own words

Before teaching CHoMP, we recommend administering a pretest of students' existing notemaking strategies. Using a one-page expository text, such as an Informal Reading Inventory for your grade level, instruct students to "show how you normally make notes." Ask them to make notes using pens and highlighters and then to write a summary based on their notes. In our experiences, during this pretest, students highlight too much information, write verbatim notes, and write a mostly verbatim summary. Use this same procedure for a post-test to observe changes in your students' notemaking. We have observed dramatic changes from our students.

Introduce CHoMP as a generalizable strategy for notemaking that will help students not only in your class but also in other classes and the future. We have had students brainstorm the uses of notemaking at this point to ensure they understood the purpose of the lesson and potential for transfer. After presenting the purpose, model the first step of CHoMP (crossing out) on the overhead with a single paragraph such as the one shown in Figure 3. For example, you might say, "When I make notes, I don't want to waste time writing extra words. So, I'm going to start by crossing out all of the 'little' words in this paragraph, such as 'the,' 'a,' and 'of.' Watch me as I do a few of these, then raise your hand to suggest some other words that I can cross out." After sufficient modeling, provide additional paragraphs for guided and independent practice, and for homework, if desired. Most students find this first step easy; in fact, Figure 3 was produced by a seventh grader with severe learning disabilities.

For CHoMP Step 2 (highlighting), repeat the modeling, guided practice, and independent practice procedure used with Step 1. This time, demonstrate the process of highlighting important information. As our eighth-grade teacher described earlier, this is generally the most difficult step for students because it is hard for many of them to discern what is *important* versus merely interesting or unusual. We found it extremely helpful to model this decision-making process using a teacher think-aloud at the overhead. For instance, you might say, "I'm going to start by highlighting 'Siberian tiger' because it's the subject of the paragraph. Next, since this whole paragraph is about how the tiger hunts, I'm going to highlight 'hunting.' I'm also going to highlight the types of prey because that

FIGURE 3. Example of CHoMP Step 1: Crossing Out

The Siberian tiger spends a lot of time hunting because only about one in ten of its hunting trips is successful. Its preys mainly on deer and wild pig, but it also eats fish. Creeping to within 30 to 80 feet of its victim, the tiger pounces and grabs the prey by the nape of the neck with its back feet still planted firmly on the ground. If the tiger misses its prey on the pounce, it may chase it for up to 650 feet but rarely catches it.

FIGURE 4. Example of CHoMP Step 2: Highlighting

The Siberian tiger spends a lot of time hunting because only about one in ten of its hunting trips is successful. It preys mainly on deer and wild pig, but it also eats fish. Creeping to within 30 to 80 feet of its victim, the tiger pounces and grabs the prey by the nape of the neck with its back feet still planted firmly on the ground. If the tiger misses its prey on the pounce, it may chase it for up to 650 feet but rarely catches it.

seems important to remember. . . ." Continue with the think-aloud procedure until you feel the students understand your rationale for what is important. Then, you can have students take turns doing think-alouds, using a gradual release of responsibility model (Pearson and Gallagher 337–38). Figure 4 shows a student's highlighted text.

In preparation for CHoMP Step 3 (making notes), model a variety of notemaking methods, such as abbreviating, truncating, making lists, using symbols, and drawing. You can use any type of text to model these methods, everything from shopping lists to excerpts from a content-area textbook. Through diverse examples, make sure students understand what you mean by abbreviating and truncating. Lists can be taught quickly to this age group (e.g., apples, oranges, and bananas are all part of what category?). Mathematics is an easy way to help students make a connection to using symbols. Emphasize that there is no right or wrong way to make notes since it is a highly individualized process; students should use whatever method is *fastest* for them and helps them to *remember the important information.* Then, return to the texts with which the students have been working to model and practice making notes. Figures 5 and 6 show two students' different approaches to making notes about the Siberian tiger text.

Finally, for CHoMP Step 4 (put in own words), have the students use their notes to write a summary in their own words. We found this step was most effective when students did not refer to the original text. Figure 7 shows one student's final notes, which were creatively and accurately paraphrased from the original text. As evidence of CHoMP's promise as a notemaking strategy, the summary in Figure 7 was produced by a seventh grader with learning disabilities whose initial research project was 100 percent plagiarized from a single source.

The Reality: Careless Notemaking

During our research in this area, we analyzed the notemaking practices of our Massachusetts eighth graders to learn how students make notes on their own, without instruction. Our first discovery was that eighth graders tend to make notes scarcely. Two weeks of the students' six-week research project were dedicated to searching for information

FIGURE 5. Example of CHoMP Step 3: Making Notes (Using Truncation and Lists)

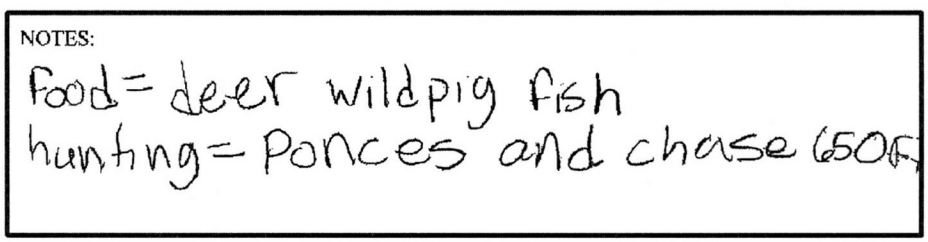


FIGURE 6. Example of CHoMP Step 3: Making Notes (Using Abbreviation [s.t. for Siberian tiger] and Drawing)

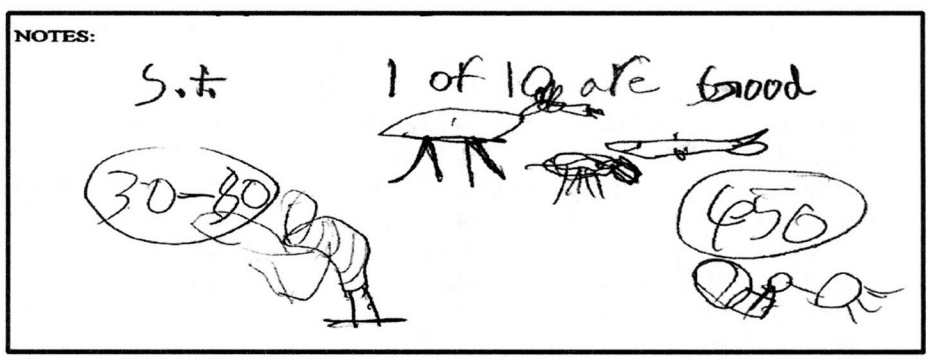
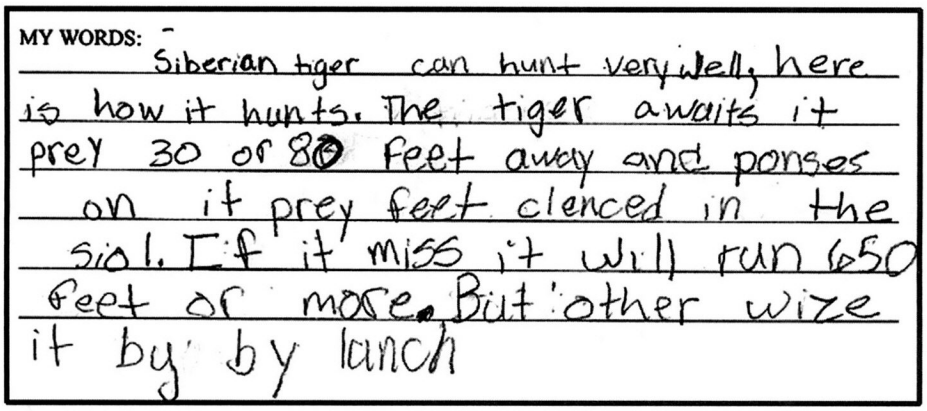


FIGURE 7. Example of CHoMP Step 4: Put in Own Words



online and notemaking. During this time, the teacher gave the students adequate time during class to gather information for their projects, but the eighth graders saved an average of only *five* notes in their electronic notepads. We were surprised by this low number, unable to envision how students could produce a robust research project based on just five research notes.

Taking information and converting it into knowledge is like spinning straw into gold.

On examining the students' notepads, we found that the students used four different strategies for making notes (described below). As educators, we possess varying levels of concern and appreciation for these different forms of notemaking. We were most concerned that, on average, only 16 percent of a student's notes were paraphrased, while over 75 percent were copied directly from the Web sources.

> Copy and Paste Large Chunk: The majority of notemaking we observed consisted of students' copying and pasting multiple paragraphs of text from individual Web sites into their notepads. On average, students used this strategy for 45 percent of their notemaking. Our main concern with this strategy was that when copying and pasting large chunks of text, the students did not demonstrate thoughtful or strategic thinking about the information they were collecting. An alternative to this strategy is simply printing a Web page deemed to contain desired information. As one eighth-grade girl told us, "I usually copy and paste it to Word. And after that I print it and read it over. Or I just print it from the Web page." While this notemaking strategy can save time initially, it postpones the inevitable chore of extracting key information from the collected content. The challenge for teachers is to make sure students eventually do evaluate and synthesize this material.

> Copy Small Chunk: The second most popular strategy we observed was copying less than four lines of text (approximately fifty words). We observed students using the copy and paste tools to make notes this way, as well as manually retyping sections of text verbatim. Students copied small chunks for 32 percent of their notemaking on average. We appreciated that this strategy was more selective than copying large chunks; however, we were still concerned that copying even small chunks of text could lead students inadvertently to plagiarize in their final products.

> Paraphrase: From an instructional standpoint, paraphrasing was the strategy we liked most. We felt that the students who paraphrased were selective about the content they collected, evaluated its appropriateness, and then attempted to synthesize this material. One eighth-grade boy described this approach to us: "I'd look at a certain paragraph and pick out whatever useful it had and put it down in my own words." However, we were disappointed to see that the students only used this strategy during, on average, 16 percent of their notemaking.

> Note to Self: We also observed some students writing reminders to themselves about particular Web sites, a notemaking strategy we had not anticipated. For example, one student identified sites with content she wanted to read in more detail later: "This is a really informative site, one that should be used as a good resorce [*sic*]." Another eighth grader kept track of sites that contained pictures he might use in his skateboarding diorama and PowerPoint presentation, saving notes such

as, "lots of info & pics on house and backyard halfpipe." The "note to self" notemaking strategy was the least common of the four. On average, the students used this strategy for only 4 percent of their notemaking.

The relatively few notes collected by our eighth graders and the lack of synthesis present in the notes they did make led us to look more closely at notemaking practices as we continued our research. Within the fifth-grade class, we observed that during the short Web-based research assignments, the students tended not to make *any* notes, with only a third of the sixteen fifth graders reporting that they made notes during the research task. When asked, the students explained that they didn't make notes because they didn't feel the need. Typical reasons included, "because I could keep the info in my mind" and because the information source and writing tool were both on the computer. It seems that these students considered notemaking exclusively as a tool for reducing cognitive load. However, the CHoMP notemaking strategy described above accentuates that making notes is useful for more than simply helping students remember what they have read.

The Promise: Information Transformation

We piloted the CHoMP notemaking strategy in both our seventh- and ninth-grade special education classes with twelve students and four teachers. We were pleased that the students demonstrated improvement when using the strategy. Specifically, five of the six seventh graders, who, we reported earlier, had extensively plagiarized their initial research projects, created Web pages with original content for their final projects. In addition, the teachers told us they liked the strategy. In fact, after our pilot, the seventh-grade teacher presented CHoMP to her entire seventh-grade team and received positive feedback from her peers.

Through these pilot tests, we have found that CHoMP resonates with teachers and their instructional objectives. One of the ninth-grade teachers reiterated that during notemaking, creating knowledge from information must be an active process. She explained, "You can highlight and not actually be learning anything. Until you have written something and passed through your own brain, you have not necessarily interacted with the text." With the CHoMP strategy, students actively engage with the source text. They highlight key points and then write and rewrite this information in their own words to help internalize the content and transform it into usable knowledge.

Based on our research experiences, we think the CHoMP strategy has promise for helping students to paraphrase source documents and avoid plagiarism in their research projects. However, students still need literacy foundations and additional strategies for producing high-quality research products. Analyzing students' work after CHoMP, we saw several areas where the students still need support, one of which was notemaking-related. In both the final research projects and notemaking exercises, we observed some students misinterpret information from their sources. For example, based on the Web source in Figure 8, one student mistakenly reported in her final project that Hilary Duff "dated Aaron Carter when she was 7 and 14!" As this example demonstrates, basic reading-comprehension skills are essential for conducting research successfully and particularly for notemaking. If students' notes are inaccurate or unclear, it could lead them to report erroneous information. This example also reminds us that avoiding plagiarism is only one of many instructional goals when teaching students to read, write, and re-present research.

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Parting Thoughts

Middle school and high school are critical times for teaching foundational skills students will use later

FIGURE 8. Source text from http://www.4reference.net/encyclopedias/wikipedia/Hilary_Duff.html

. . . Duff was the star of the successful Disney Channel show *Lizzie McGuire* and has appeared on the covers of teen magazines and become highly popular among children commonly called "tweens," *i.e.* those between the ages of 7 and 14. She dated singer Aaron Carter, brother of The Backstreet Boys member Nick Carter. . . .

in college and their careers. Research projects are an authentic vehicle for this preparation. The ultimate goal of most research projects is for students to learn something and re-present what they have learned to others. This can be an empowering task for students. Taking information and converting it into knowledge is like spinning straw into gold. Through students' independent thoughts, they are able to produce and contribute knowledge, a significant accomplishment in the present and an important skill for the future.

The complex nature of research-project assignments also provides opportunities for students to develop fundamental subskills, such as strategic notemaking. Through explicit and repeated notemaking practice, students can make paraphrasing a habit. The benefits of paraphrasing during notemaking are greater than simply preventing unwitting plagiarism. By actively engaging with the material to write it in their own words, students have the opportunity to process the content and develop a better understanding of it. Centuries ago, Sophocles stated that "knowledge must come through action." This is particularly pertinent guidance in today's information age as the current generation of students transforms information into knowledge.

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Sarah I. Roody. "Teaching High-School Seniors the Scientific Attitude toward Life." *EJ* 35.1 (1946): 33–36.