HOW SHOULD MIDDLE-SCHOOL STUDENTS WITH LD APPROACH ONLINE NOTE TAKING? A MIXED-METHODS STUDY

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Abstract. **This explanatory sequential mixed-methods study explored how the encoding of text ideas is affected when students with learning disabilities (LD) take notes from Web-based text. In the quantitative phase of the study, 15 students took three kinds of notes – typed, copy and paste, and written – with each kind of notes addressing a different topic. After taking notes, students performed poorly on two immediate measures of facts learning. Cued-recall test performances were best for topics noted by writing, whereas multiple-choice test performances were best for topics noted by copying and pasting. Students performed worse on the cued-recall test when it was readministered four days later. In the qualitative phase of the study, followup interviews indicated students preferred copying and pasting their notes (for practical reasons) and found typing notes to be distracting, which made learning problematic. A textual analysis of students' notes confirmed that students took mostly verbatim notes when typing or writing, which has been linked to shallow processing, and perhaps further accounts for the low level of learning that occurred. The mixing of quantitative and qualitative data (in the qualitative data analysis phase of the study), along with learning and motivation theories, provides justification for teachers to instruct middle-school students with LD to use copy and paste to take notes from Web-based sources.**

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Access to the general education curriculum is mandated for students with disabilities by the Individuals with Disabilities Education Act Amendments of 1997 (*Federal Register,* 1999) and reiterated in the 2004 reauthorization (Council for Exceptional Children, 2004). The importance placed on student access and progress requires educators to provide students with disabilities instruction on the essential skills and concepts emphasized through the general education curriculum.

Advances in technologies over the last decade may offer a path to improved strategies for students with learning disabilities (LD) to successfully access and progress through the general education curriculum. Note taking is an especially useful skill that can be applied to learning from Web-based sources.

Web-based note taking is increasingly common, as students are more readily using the Internet for research purposes (Dabbagh & Bannan-Ritland, 2005). However, to learn from online sources students need more than access to learning technologies; they need proper instruction related to online learning (Dabbagh & Bannan-Ritland, 2005).

Recent research has addressed this issue, suggesting that teachers can improve the effectiveness of students' Web-based note taking by providing students with a cued note chart (to ensure appropriate information is gathered) or by instructing students to type their notes instead of copying and pasting them from Internet sources (Igo, Bruning, McCrudden, & Kauffman, 2003). Unfortunately, to date only general education students have been included in Web-based note-taking research. More specific investigation is needed if generalizations are to be made to the instruction of students with LD.

Facilitation of Encoding

Note taking can promote learning in two phases: the external storage phase and the encoding phase (Divesta & Gray, 1972; Kiewra et al., 1991). In the external storage phase, learning occurs as students study a set of notes that have already been recorded. For example, when a student studies her prerecorded lecture notes in preparation for a test, she employs the external storage phase of note learning. In the encoding phase, learning occurs as students take notes. For example, students who take notes while listening to a lecture can sometimes comprehend the lecture better (Kiewra, 1985) and remember more of the ideas presented (Aiken, Thomas, & Shennum, 1975) than students who simply listen. In short, although studying notes can result in a great deal of learning, students can encode (or learn) information through the note-taking process alone.

The amount of information students encode through the note-taking process is largely a function of the kinds of notes they take (Igo et al., 2003; Igo, Bruning, & McCrudden, 2005a; Slotte & Lonka, 1999). For example, students who take summary notes remember more from lectures than students who take verbatim notes (Slotte & Lonka, 1999). Similarly, note taking that involves identification of main ideas or paraphrasing seems to boost encoding (Blanchard, 1985; Hidi & Anderson, 1986; Igo et al., 2003; Mayer, 2002; McAndrew, 1983; Rinehart & Thomas, 1993).

One explanation for these differences in encoding is that the mental processes required to create summaries and paraphrases (or to identify and note main ideas) are deeper than those required to record verbatim notes (see, e.g., Craik & Lockhart, 1972). Consequently, researchers have described the boost in encoding related to different kinds of note taking as a depth-of-processing effect (Divesta & Gray, 1972, 1973; Igo et al., 2003; Igo et al., 2005a; Mayer, 2002), where deeper levels of thinking result in more encoded ideas than shallow levels of thinking.

Depth-of-processing effects have been documented in research addressing students with LD (Boyle & Weishar, 2001). For example, students with LD can deepen their processing by relating new information to prior knowledge (Alley & Deshler, 1979) or by identifying main ideas (Deshler, Shumaker, Alley, Clark, & Warner, 1981; Ellis & Lenz, 1987) while they take notes. In short, encoding is facilitated by the deep kinds of thinking that are necessary to create certain kinds of notes.

Web-Based Note Taking

The depth-of-processing effect has also been documented in Web-based note-taking environments. For example, in a study by Igo et al. (2003) general education high-school students who typed notes from Web-based text were likely to create paraphrases as a default strategy. Presumably, using the paraphrase strategy required them to deepen their mental processes; in turn, the students who typed notes learned more than students who copied and pasted their notes from Web-based text.

Further, Igo et al. (2005a) found that college students who copied and pasted notes with greater text selectivity encoded more ideas from Web-based text than students who pasted notes less selectively. In post-note-taking interviews, the selective pasters described engaging in deeper mental processes (e.g., evaluation of text ideas) while taking notes than the less selective pasters. Again, the encoding function of Web-based note taking was related to the depth of processing in which students engaged.

To date the encoding phase of Web-based note taking for students with LD has been neglected in the research literature. Thus, the depth-of-processing effect that has been documented with general education students may not materialize in populations of students with LD. First, students with LD often struggle to process text in deep, meaningful, or strategic ways (Mastropieri & Scruggs, 2000; Mercer & Mercer, 2001; Sawyer, Graham, & Harris, 1992). Students with LD face other obstacles to encoding, such as the distraction imposed by spelling and punctuation monitoring (Hughes & Smith, 1990; Poteet, 1979). Consequently, in Web-based note-taking environments, students with LD may not choose to paraphrase while typing notes and, therefore, may not attain improvements in encoding. Also, it is unclear how students with LD are affected by the use of copy and paste while taking notes. Although general education high-school students (Igo et al., 2003) and college students (Igo et al., 2005a) learn less when they use their own copy-and-paste strategies, the same might not be true for students with LD. Finally, when students with LD take notes from the Web, it might be more beneficial for them to write their notes instead of taking electronic notes.

The purpose of this sequential, explanatory mixed-methods study was to explore the encoding function of Web-based note taking for middle-school students with LD. In the quantitative, first phase of the study, 15 students read Web-based text covering three topics and noted each topic in a different way: by writing, typing, or copying and pasting. In latin-square fashion, each student took three kinds of notes, but the combinations of their topic and note-taking styles differed, so that different students pasted, typed, or wrote notes on different topics (see Figure 1). After taking notes, students were (a) immediately tested to examine any differences in encoding prompted by the three note-taking techniques and (b) given a delayed measure of recall of text ideas (four days later).

In the qualitative phase of the study, each student was interviewed to explore their perspectives of the three kinds of note taking, examine how they approached using the three techniques, and further explain the quantitative findings. Finally, a textual analysis of students' notes was conducted to help explain students' strategies, learning, and mental processing.

Quantitative Hypotheses and Predictions

Two competing hypotheses were constructed for the quantitative phase of the study: the depth hypothesis and the transfer-appropriate hypothesis. The depth hypothesis stems from levels-of-processing theory and its related research (Craik, 2000; Craik & Lockhart, 1972). According to this theory, students who process text at deeper levels encode more information while taking notes than students who process text at shallower levels (Cermak & Craik, 1979; Craik, 2000). In previous research, students were found to display depth-of-processing effects (and learned more) when they typed paraphrase notes but not when they took copy-and-paste notes (Igo et al., 2003). In fact, in an in-depth mixed-methods study, Igo et al. (2005a) found that many college students take copy-and-paste notes in a decidedly mindless way, pasting large amounts of text and remembering little (if anything) of what they had pasted. Thus, for purposes of this study, the depth hypothesis predicted that learning will be more robust when notes are taken by typing or writing, as these two techniques allow students the opportunity to create paraphrases and deepen their processing. On immediate and delayed tests, then, students should perform better on items assessing knowledge of topics that were written or typed than on items assessing knowledge of topics that were pasted.

The transfer-appropriate hypothesis stems from transfer-appropriate processing theory and its related research (Baguley & Payne, 2000; Bransford, Franks,

Figure 1. Latin-square assignment of students (numbers) to conditions (note-taking styles x topic).

Students/*topics*	*buaxite*	*coal*	*uranium*
1, 7, 13	Type	Write	Paste
2, 8, 14	Type	Paste	Write
3, 9, 15	Write	Paste	Type
4, 10	Write	Type	Paste
5, 11	Paste	Write	Type
6, 12	Paste	Type	Write

Note. The three treatment conditions (type, write, paste) were assigned randomly to each student.

Table 1
Summary of Participant Demographic Information

Participants	
Grade Level	
7th grade	10
8th grade	5
Gender	
Male	12
Female	3
Total	15
Age	
Mean	13 years 10 months
Range	13-14 years 6 months
Race/Ethnicity	
Anglo	9
Hispanic	1
African-American	5
SES	
High	0
Middle	1
Low	14
Disability Category	
LD	11
E/BD	2
OHI	2
Educational Placement	
Time in Sp. Ed. Placement	>60%
Level of Placement	Self-Contained
Intelligence	
Mean (SD)	82 (11.8)
Range	68-100
Reading Achievement	
Mean	4th grade
Range	2nd-7th grade

Note. Intelligence as measured by WISC III, Universal Nonverbal Intelligence Test, and Stanford-Binet Intelligence Scale.

Morris, & Stein, 1979). According to this theory, memory performances (and encoding) are maximized when the cognitive skills used in learning are the same as the cognitive skills required by an assessment procedure. As such, this hypothesis predicts that when students copy and paste their notes (where they must identify and select the appropriate information to note), their performances will be highest on a multiple-choice test (because they are required to identify and select the appropriate information for their answers). Similarly, this hypothesis predicts that when students type or write their notes (where they must generate words to note), their memory performances will be highest on a cued recall test (where they must generate words for their answers).

METHOD

Participants

Participants were 7th- and 8th-grade students in a rural southeastern town. The middle school has a large number of migratory students and students from low socioeconomic backgrounds. The 15 students who participated in the study were from an intact self-contained social studies classroom. Ten were in 7th grade and 5 were in 8th grade. Twelve participants were male and 3 were female, ranging in age from 13 years to 14 years 6 months.

Eleven of the participants were identified with a learning disability, 2 students were identified with emotional and behavioral disorders, and 2 students were identified with other heath impairments (OHI) for attention difficulties. All 15 participants were described by their teacher as being poor readers with low motivation. The participants' demographic information is summarized in Table 1. It is important to note that the students' achievement scores were not available to the researchers and, therefore, are not reported. The number of participants was limited to 15 by the researchers to provide experimental content consistent with the teacher's goal and the number of classes covering the same content.

The students' low achievement in all areas is evident in their achievement test scores, which were obtained at the district office. Seven students had been assessed using the Brigance Comprehensive Inventory of Basic Skills. On math computation all 7 students scored at the 3rd-grade level and ranged from 2nd to 4th grade on problem solving. Reading scores for word recognition, oral reading, and comprehension ranged from 2nd to 7th grade. Writing scores for spelling and sentence writing ranged from 3rd to 5th grade. Five students had been assessed with the Wide Range Achievement Test. For math, reading, and spelling, their scores ranged from 2nd to 6th grade. The overall achievement of three students is not reported because of incomplete files as a result of students having recently moved into the school district.

Materials

Materials included a researcher-constructed text passage from which students took notes. The passage was 763 words long, described three native Australian minerals (coal, bauxite, and uranium), and was presented on a single, continuous Web page (HTML document) accessed through Microsoft Internet Explorer. The text was of comparable length to text used in previous text-encoding research (e.g., Blanchard, 1985; Golding & Fowler, 1992; Marxen, 1996; Peterson, 1992; Spiegel & Barufaldi, 1994; Wade & Trathen, 1989). The text described each mineral along parallel lines, identifying each mineral's (a) supply, (b) production, (c) uses, (d) geographic location, (e) first characteristic, and (f) second characteristic. After controlling for certain vocabulary words that occurred several times throughout the text (e.g., bauxite, uranium, nuclear), the Flesh-Kincaid grade level of the text was 6.4.

Students took notes in a Web-based, note-taking tool and (for one topic) on a paper chart. The note-taking tool was a word-processing chart fit with the text's structure. It contained three columns corresponding to the three text topics (minerals) and six rows corresponding to the six text categories. The three columns were labeled from left to right as *bauxite, coal,* and *uranium*. The six rows were labeled *production, supply, uses, location, first characteristic,* and *second characteristic*. Thus, at the outset, the tool presented students with 18 blank cells, 6 for each mineral addressed in the text, with cues directing them to find information intersecting topics and categories. The tool itself could be minimized, maximized, or reduced in the same way as other computer programs. For example, students could choose to have the tool appear on the screen as they took notes, or they could expand the text to cover the screen and hide the chart.

The paper note-taking chart was a paper version (8-1/2 x 11 in.) of the online note-taking tool. It presented students with the same cues and blank cells as the Web-based tool, but students filled in one topic by writing in the paper chart, whereas two topics in the Web-based tool were filled by typing and copying and pasting.

Dependent Measures

Two researcher-constructed tests assessed student learning of facts from the text. The cued-recall-of-facts test was administered twice: immediately after the note taking and after a four-day delay. Students filled in a cued paper chart (similar to the online note-taking chart) with all, or any part of, the information that they could remember reading or typing, writing, or pasting into their notes. The columns and rows were labeled in the same way as the note-taking chart; the cells were blank. The test was scored by awarding 1 point per idea recalled and placed in the correct, cued cell corresponding to an idea from the text, whether the idea was originally noted or not. Two raters scored the quiz, blind to experimental conditions, with a clearly acceptable level of inter-rater reliability (Cohen's $K = .89$).

An 18-item multiple-choice test ($\alpha = .73$) required students to recognize factual information presented in the text. For each item, students read a fact and then decided to which of the three minerals it corresponded. One point was awarded for each correct response.

Procedure

Prior to the experiment, the students received a brief, informal tutorial from their teacher on how to use the type and copy-and-paste functions of a computer. The teacher indicated that while most students were already familiar with each technique, they struggled when using them.

The experiment occurred over one day, with the delayed test taking place our days later. Students met in their usual classroom where class roll was taken; students were then assigned randomly to one of six experimental groups that differed in the combination of topics to be noted and kinds of notes to be taken (see Figure 1). Next, students were given an overview of the note-taking task. Specifically, the primary researcher told the students that they (a) were to read and take notes over material as per their assigned condition, (b) would be given two brief tests after they finished, and (c) would be given another brief test four days later. The students then moved as a group to the school's computer lab.

Next, students logged on to computers (which they were allowed to choose) and created user names and passwords (which permitted them to use the note-taking tool and allowed their notes to be saved on a university server and printed). The students were instructed by the primary researcher to take notes using the cues provided in the chart – for example, *uses* and *supply* – to read and take notes at a pace comfortable to them, and to take as much time as they needed to complete their notes. Students then read the text, completed their notes, and saved their notes on the computer (and turned in their paper note sheets). Most students completed the note-taking task in 14-18 minutes. Because students finished the note-taking portion of the experiment in varying amounts of time regardless of experimental condition, and because each student took all three kinds of notes, differences in engagement time were judged to be minimal and realistic of typical classroom behavior.

RESULTS

Immediate

ANOVA results indicated a significant effect on students' immediate cued recall test performances, F (2, 42) = 4.8, $p < .05$. The strength of the relationship between kind of note taking and cued recall was strong as assessed by eta square, with the kind of note taking accounting for 17% of the variance in cued recall. Results of the LSD post-hoc test indicated that cued recall was significantly higher for topics that were noted

Table 2
Means Summary of Two Tests and Analysis of Variance

Measure and Note-Taking Style	Mean	*SD*	*F*	Power	η^2
Cued Recall					
Write	1.47*	1.35	4.51	.84	.17
Type	.87	.99			
Paste	.33	.61			
M/C Facts					
Write	2.87	1.30			
Type	2.73	1.02			
Paste	4.07*	1.31	3.96	.71	.16

* $p < .05$.

by writing than for topics that were noted by pasting (see Table 2). Recall performances for topics that were noted by typing fell between those of writing and pasting and did not differ from either.

Results also indicated a significant effect on students' multiple-choice test performances, F (2, 42) = 3.96, $p < .05$. The strength of the relationship between the kind of note taking and fact identification was strong as assessed by eta square, with the kind of note taking accounting for 16% of the variance in fact identification. Results of the LSD post-hoc test indicated that multiple-choice performances were significantly higher for topics that were noted by pasting than for topics that were noted by writing and typing (see Table 2).

Delayed

ANOVA results indicated no significant effect on students' delayed cued recall test performances, F (2, 42) = 1.6, p = .38. Performance means for students' recall of text ideas ranged from .67 points for written topics to .53 for typed topics and .24 for pasted topics.

DISCUSSION

Quantitative Phase

The experimental results did not support our depth hypothesis, which predicted that learning through writing and typing notes is superior to learning through pasting notes. In previous research, typing notes produced higher levels of student learning across different tests assessing learning from Web-based text. This was attributed to the use of paraphrase strategies and subsequent deepening of mental processes during note taking (Igo et al. 2003). In the present study, however, students' writing and typing behaviors (which presumably afforded them the opportunity to paraphrase) yielded inconsistent performances across tests. A deepened level of processing should have resulted in boosted performances on each test. The absence of such consistency suggests the absence of deep processing.

Also in previous research, copying and pasting notes decreased learning. This was attributed to the imposition of verbatim note taking on the student, which has been linked to shallow processing in previous research (Igo et al., 2003; Slotte & Lonka, 1999). In the present study, however, copying and pasting yielded higher performances on one of the immediate tests (multiple choice). This is not to say that the students were engaging in deeper levels of processing while pasting, however, because, again, the deepened processing would have resulted in consistently higher performances across tests.

Finally, the absence of deep processing is made clearer by the results of the delayed, cued recall test. On average, students recalled about half of an idea across topics noted by all three kinds of note taking. This result, coupled with the relationship between depth-of-processing theory and long-term memory (Craik, 2000), suggests students were not thinking deeply while they were taking notes.

By contrast, our results do support the transfer-appropriate hypothesis, as students' test performances differed with respect to both note-taking style and test type. In transfer-appropriate fashion (Baguley & Payne, 2000), students tended to perform better when the type of engagement during a particular kind of note taking was closely matched to the type of engagement required by the test. For example, points were awarded on students' cued recall tests only if students were able to generate correct written facts in the appropriate cell of their cued recall charts. They had already done this once, during the note-taking phase of the experiment when they noted topics by writing. The cognitive engagement necessary to complete the written portion of the notes was closely related to the engagement necessary to answer the cued recall test, and performances were highest when there was such a match. The same effect was evident in the multiple-choice test, which required students to search for and then select information for their answers. Performances were highest for topics that were copied and pasted, which required students to select and paste the correct ideas into notes.

This is an interesting finding because transfer-appropriate processing effects are typically regarded as weak learning effects (see, e.g., Neath, 1998), occurring in the absence of deep processing. Again, for evidence of this, see the means in Table 1, which suggest that students, in general, learned little during any of the three kinds of note taking. Specifically, 6 points were possible in the cued recall of facts test, but the mean for each kind of note taking on the immediate test was below 2 points, with pasting and typing below 1 point. As expected, performances were even worse on the delayed test, where all means fell below 1 point.

Although the experimental findings support the transfer-appropriate hypothesis, they do not explain the weak learning effects. Certain other characteristics of the results also are unexplainable in light of only the experimental findings. For example, students' performances were slightly lower for typed than for written notes. This phenomenon occurred on each dependent measure, and it is not explained by either of our theoretical hypotheses. Perhaps this finding was due to the small number of students who participated in the study. Similarly, the relatively small number of items on each dependent measure might have influenced the results. But each of these explanations might also be inconclusive. In cases where quantitative, experimental inquiry does not provide enough description of a phenomenon, researchers can use qualitative followup procedures to aid understanding (Creswell, 2003; Newman & Benz, 1998; Tashakkori & Teddlie, 1998).

Qualitative Phase

In order to gain a more detailed view of the students' note-taking behaviors and attitudes, as well as the impact of those behaviors and attitudes on test performances and processing, two kinds of qualitative data were collected and analyzed: interview data and students' notes. The interview data were analyzed to ascertain the students' least and most preferred note-taking techniques, to describe why the students subscribed to those beliefs, and to help explain the experimental results. Further, students' notes were analyzed to examine how students approached using the three kinds of notes and to explain how their approaches might account for the experimental findings.

Analysis of Notes and QUAN-QUAL Data Mixing

Students' notes were analyzed in three ways. First, they were checked for completeness. As documented in previous research using cued note charts (see, e.g., Igo et al., 2003; Kiewra, 1989), students in the current study completed their note charts appropriately. All cells were filled in each student's chart. The notes also were checked for appropriateness of ideas. Again, as in previous research, the information in each note-taking cell correctly corresponded to the cues that were provided in the chart. Because the chart and cues were fit with the text's structure, the notes were appropriate to the text as well. Finally, the notes were checked for the presence or absence of paraphrases and the presence or absence of verbatim text ideas, except for topics that were noted by pasting, which were all identical to the original text.

In general, students' notes – whether typed or written – were constructed in verbatim fashion. This preference has been documented in older students with LD (see, e.g., Suritsky, 1992), whereas general education students prefer to create paraphrases in lieu of verbatim notes (Igo et al., 2003). In the present study, some note-taking cells were filled with verbatim sentences from the text, but more often they contained sentence fragments from the original text (varying in length from two to seven words). In most cases, students selected sentence fragments appropriately. That is, no real meaning was lost through their choice to include fewer words rather than entire sentences.

In some cases, albeit few, students attempted to paraphrase text ideas in their notes. Interesting, the paraphrases were short. In fact, in most cases, they simply took the form of word substitution rather than typical sentence or paragraph paraphrases. For example, one note cell was cued to be filled with the uses of uranium. Whereas the text presented the uses of "providing electrical power" and "used to make nuclear weapons," one student wrote "bombs." There were other similar examples of such paraphrase attempts. But unlike when students wrote or typed verbatim sentence fragments, when they attempted to paraphrase, part of the text's meaning was lost in the transition of ideas from the original text to the students' notes. In the "bombs" example given above, the student's notes were perhaps not as complete as those of another student, who chose to write verbatim each of the uses of uranium. In short, in the rare cases where students chose to take paraphrase notes, their attempts seemed to come at the expense of note quality. That is, they built notes inferior to those that contained verbatim text ideas.

The analysis of notes thus further confirmed our basis for rejecting the depth hypothesis in the quantitative phase of this study. As mentioned, in previous research, verbatim note taking has been linked to shallow levels of processing (Slotte & Lonka, 1999), and shallow levels of processing have been linked to poor memory performances (Craik, 2000). Because students in the present study performed poorly on the tests and took mostly verbatim notes, the absence of deep processing becomes an increasingly more plausible account of our results.

Student Interviews

Immediately following completion of the two tests, students were interviewed separately by the primary researcher, who typed their responses verbatim on a laptop computer. After each student's responses were recorded, they were read back to the student to ensure that they communicated what had been intended.

The items to which students responded came from a protocol consisting of seven questions/prompts:

- Which type of note taking did you like the best?
- And why is that so?
- Which type of note taking did you like the least?
- And why is that so?
- Explain the process you used when you typed your notes.
- Explain the process you used when you pasted your notes.
- Explain the process you used when you wrote your notes.

Additional questions were asked to further prompt answers from interviewees who at first gave brief or non-descript answers to one or more of the questions. In general, the interviews lasted from four to six minutes.

After the interviews, students' responses were printed and cut into slips of paper, containing a statement addressing one of the questions. A predetermined set of

Table 3
Condensed Effects Matrix That Organized the Interview Data

Note Taking	Write	Type	Paste	Theme	Exemplar Quote
Preferred Method	2	1	12	1. 12 students preferred pasting; 10 because it removed the need to monitor spelling and grammar.	"When I pasted stuff, I … took it and put it in without worrying about how it looked."
				2. 3 students who were confident in their spelling found writing/typing notesto be the most time efficient.	"I could write faster than I could do the others."
Least Preferred	2	13	0	3. 11 students described the worry and stress of monitoring spelling while writing and/or typing notes.	"... sometimes I had to look back [to the text] a couple of times for the same word if I didn't know how to spell it."
				4. 6 students found typing notes cumbersome, as need to monitor spelling was amplified by the need to search key-board for the correct letters.	"It was hard to find some of the [letter keys ...] I would forget how to spell [the word] I was typing."

coding schemes was subsequently used to sort the statements into three categories: typed, written, or pasted notes. The statements within each category then were read and examined several times for any commonality or thread. Similar coding systems have been used in previous research (Igo et al., 2005a). For example, Igo et al. (2005a) used three predetermined categories to sort statements from student interviews into categories addressing shallow, moderate, and deep processing. In this study, some of the themes were identified easily, as students' responses to the questions were in some ways quite similar. Other themes were at first more elusive, but emerged after several examinations of the statements.

Following the prescriptions of Miles and Huberman (1994), an effects matrix was constructed to serve three purposes: organization of the interview data, explanation of effects, and drawing of conclusions. As shown in Table 3 (a condensed version of the matrix), the effects matrix organized the interview data by kind of note taking and student preference. Four themes emerged once the data were organized.

Explanation of Effects

As seen in Table 3, the first theme that emerged from the interview data relates to an overwhelming note-taking preference of the students in this study. Of the 15 students, 12 described preferring copy and paste to the other two types of note taking. We judged this to be a theme because of the sheer percentage of students who gave this answer. Previous research has documented a similar preference in high-school general education populations (Igo et al., 2003), as well as college students (Katayama & Crooks, 2003; Katayama & Robinson, 2000). Another dimension of this theme was why students preferred copying and pasting. Ten students indicated that pasting notes was their favorite because it removed the barriers of spelling and grammar while they took notes. This was not documented in the previous research with general education students.

The second theme was similar to the first, but relates to students who preferred to write notes. Although only two students described this preference, it is important to note that they both stated that writing was the easiest way for them to take notes. When the students gave this answer during the interviews, the interviewer asked them a further question, "Are you a good speller?" Each student said "yes" in response. In fact, the lone student who preferred to type his notes made it clear that he too was confident in his spelling, indicating that alleviating the spelling need, which seemed important to most students, was to these three students not an enticing feature of the copy-and-paste function.

The third theme from the interview data relates to spelling concerns as well. First, it is important to note that all students reported least preferring either to type or write notes. None assigned that label to copy and paste. Of the 15 students, 11 described worrying about spelling while taking notes as the primary reason why they disliked typing or writing. In fact, the note-taking tool had no spell-check function, so students could not "right-click" to find spelling options. Interesting, 5 students stated that they were less likely to be concerned about spelling when they were writing notes and more likely to be concerned when typing their notes. Perhaps this is because, when typed, a misspelled word looks suspiciously incorrect, whereas in handwriting the error may not appear as blatant (as indicated by one student during the interviews).

Finally, the fourth theme relates solely to typed notes. Typing was problematic for some students. Six students specifically mentioned having to search the keyboard to find the appropriate letter keys. This frustration was complicated even further for certain students. Thus, three mentioned having to look back to the text several times per word while searching the keyboard, as they tended to forget how to spell the word during the time it took to find the letters on the keyboard.

Conclusions and QUAN-QUAL Data Mixing

The four qualitative interview themes, coupled with an analysis of student notes, offer a sound explanation of the transfer-appropriate processing effects found in lieu of depth-of-processing effects in the quantitative phase of this study. First, as indicated by the analysis of notes, most students created verbatim notes; they tended to write (or type) one or two words at a time while trying to match their notes to the main text. Verbatim note taking has been linked to shallow processing with both general-education and LD populations (Igo et al., 2003; Slotte & Lonka, 1999; Suritsky, 1992). Further, during the interviews, students consistently described the need to monitor spelling while typing and writing notes. As such, they most likely would have had to shift their mental efforts away from the meaning of the text from time to time as they took notes, which can result in diminished encoding of the text ideas (Igo, Bruning, & Mcrudden, 2005b). Finally, some students described the added distraction of searching the keyboard for letters while they took notes. This, too, forces students to shift their mental efforts to a task unrelated to the message in the text.

The qualitative phase of this study also helps explain why students performed slightly better on tests for topics that were noted by writing than by typing. For example, although students indicated that spelling was a concern in both the writing and typing conditions, three students noted that they were able to write their notes more quickly than typing them. Similarly, five students described feeling less pressure to spell correctly while writing than while typing. Together, these two findings could account for the slightly higher performance on written topics, as each suggests that less time was spent on distracting tasks (see, e.g., Baddeley, 1998).

Implications for Practice

The results of the present study suggest that middle-school students with LD struggle to encode (or learn) text ideas simply through the note-taking process regardless of the kind of notes they take (typed, written, or pasted). The encoding phase, then, results in little actual learning. Therefore, it might be of optimal benefit for students to ensure clarity and completeness of their notes in order to maximize the external storage function of note taking. In other words, if students won't remember much of what they have noted, they should at least have a good set of notes to study from. The question becomes, how do we best ensure that middle-school students with LD create a good set of notes from Web-based sources?

Based on our qualitative findings, one answer is that most students should use copy and paste in lieu of typing or writing for practical, motivational and learning-related reasons. On a practical note, this population of students chose, in general, to create verbatim notes in the writing and typing conditions. Copy and paste essentially does the same thing, but it does so in a more time-efficient fashion.

In terms of motivation, students described a measure of anxiety regarding spelling and grammar while typing and writing that was not present when they pasted their notes. Copying and pasting their notes, then, would be a less intimidating and more comfortable experience when learning online. Reducing the anxiety associated with note taking (spelling and grammar concerns) may motivate students to engage in the note-taking process (Barlow, 2000; Beck, 2004; Gray, 1982).

In terms of learning, the quality of students' notes tended to suffer when they attempted to paraphrase ideas while taking notes in the writing and typing conditions. Ultimately, this would have negatively affected the potential of the external storage phase (the study of notes), as their paraphrased notes were in some ways incomplete (Divesta & Gray, 1972). Notes created with copy and paste, however, addressed the note-taking cues the students were provided.

Limitations and Future Research

At least two practical concerns with the present study should be addressed in future research. First, the use of a single text may be problematic. Because texts differ with respect to their density of ideas, content, and general length, a different text might produce different results. If possible, future research could require students to take notes from multiple texts or different texts than this study. Second, the present student included only 15 participants. A latin-square design was, therefore, employed to test the effect of the three kinds of note taking on learning. Different results might be obtained if more participants were included and assigned to three experimental groups that differ in the kinds of notes they take. Last, future research should test the external storage function of note taking by allowing students to study before learning is assessed.

In conclusion, the results from this study appear to indicate that students with LD have unique needs when it comes to gathering information from Web-based text. Because more and more students with LD are required to use the Internet and other Web-based formats for school-related activities, it is important that teachers consider these characteristics when planning instructional activities. Thirteen of the 15 students indicated a preference for using the copy-and-paste tool for note taking. If copy-and-paste note taking improves students' potential to learn, eliminates spelling errors, and benefits motivation by reducing anxiety, teachers should consider instructing their students in how to use copy and paste to take notes.

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