Note-Taking Skills of Middle School Students With and Without Learning Disabilities

Joseph R. Boyle¹

Abstract
For middle school students with learning disabilities (LD), one major component of learning in content area classes, such as science, involves listening to lectures and recording notes. Lecture learning and note-taking are critical skills for students to succeed in these classes. Despite the importance of note-taking skills, no research has been reported on the problems that school-age students with LD encounter when recording notes during science lectures. Using a sample size of 90 middle school students, the performance of students with LD was compared to students with no learning disabilities (NLD). Results found that students with LD performed significantly worse than students with NLD in terms of the type and amount of notes recorded and test performance.

Keywords
note-taking, learning disabilities, content area classes, lecture, middle school students

In special education, there have been a number of reforms that have sought to increase the number of students with disabilities in general education classes, such as science, math, and social studies classes, while at the same time increase the opportunities for students with disabilities to gain meaningful access to the general education curriculum (De La Paz & MacArthur, 2003; Maccini, Strickland, Gagnon, & Malmgren, 2008; Swanson & Deshler, 2003). As more and more students with disabilities receive their education in regular education or inclusion classes, the academic demands on them increase (Deshler, Ellis, & Lenz, 1996; E. Boyle et al., 2002), as well as teachers’ expectations for them (Browder et al., 2003). Interestingly in one national survey, 58% of the teachers wanted additional training in how to teach science classes that included students with disabilities (Fulp, 2002). Despite increases in the number of students being included in regular education classes, most students with mild disabilities have difficulty mastering the content in these classes (Lynch et al., 2007). Their poor performance is reflected in lower grades in content areas (Cawley, Kahn, & Tedesco, 1989) and poor performance on the National Assessment of Educational Progress (NAEP), in particular the science assessment. For example, on the 2005 eighth-grade NAEP science test, 73% of students with disabilities scored below even the most basic level of the test. In large, central city schools, the results are even worse, with 86% of eighth-grade students with disabilities scoring below basic. Moreover, as students progress from elementary to middle school to high school, their scores continue to decline on both state and national tests (NAEP, 2005; Scruggs, Mastropieri, Berkeley, & Graetz, in press).

One major component of learning in content classes involves listening to lectures and recording notes. Lecture learning and note-taking are critical skills. In fact, teachers have ranked note-taking and listening skills as two of the three top skills that students should have in their classes (Knowlton, 1982). When teachers were asked what teaching methods are used in their classrooms, one investigation found that 79% of content-area teachers reported that they “regularly use” or “mostly use” lectures during their teaching (Vogler, 2006). Likewise, in a national survey that included over 500 middle school science teachers, educators reported that nearly two thirds of their science classes involve students listening to and taking notes during lectures, and on average 31% of the total instructional time is spent on lectures/discussions (Fulp, 2002). Similar results were found in mathematics, as middle school teachers reported that lectures and note-taking occur in 80% of their math classes, and it takes place, on average,

¹Rutgers, The State University of New Jersey, New Brunswick, NJ, USA

Corresponding Author:
Joseph R. Boyle, Rutgers, The State University of New Jersey 10 Seminary Place, New Brunswick, NJ, 08901-1183, USA
Email: joseph.boyle@gse.rutgers.edu
36% of the time in these classes (Hudson, McMahon, & Overstreet, 2002).

Note-taking skills should not be underestimated. Whether students are recording notes from scientific observations, during class discussions, or at home from textbooks, note-taking skills are important to acquire, used almost daily, and utilized throughout their lifetime. For students with disabilities to succeed in school, they must learn this essential skill or experience the consequences, mostly in the form of poor performance on tests (Cawley et al., 1989; Laidlaw, Skok, & McLaughlin, 1993). Not only do these teacher lectures serve as a primary means of conveying content information to students, but researchers (Putnam, Deshler, & Schumaker, 1993) have reported that teachers’ “lectures were the major source of information (upon) which test questions were based” (p. 340). Moreover, teachers noted that in their secondary content classes almost half of a student’s grade was derived from students’ performance on these tests (Putnam et al., 1993). As such, general education teachers expect that all students will be able to take notes well in order to do well on their tests.

In addition to performing well on tests, there are other reasons why students need to be efficient note-takers. The two most common are: note-taking aids student understanding of lecture information and notes serve to preserve lecture information, in the form of a written document, for later study. Researchers (Aiken, Thomas, & Shenum, 1975; Bretzing & Kulhavy, 1979; DiVesta & Gray, 1973; Titwsworth, 2004) have long demonstrated that student note-taking during lectures is advantageous for increasing comprehension and improving later recall of information. For example, students who took notes increased their attention to lecture material (Kiewra, 1987), were actively engaged in lectures (DiVesta & Gray, 1973), paraphrased and elaborated on lecture information (Mayer, 1996; Suritsky & Hughes, 1996), sought to clarify their understanding of confusing points (Ruhl & Suritsky, 1995), effectively learned concepts in middle school classes (Risch & Kiewra, 1990), and increased test performance of middle school lecture content (Laidlaw et al., 1993). In particular, this last study demonstrated that when typically achieving students did not record notes (i.e., during baseline periods), on average their quiz scores were 44% but increased to 79% when they recorded notes.

Despite the importance of note-taking skills, relatively little research has been reported on the problems that students with learning disabilities encounter when recording notes during lectures. In fact, only two studies (Hughes & Suritsky, 1994; Suritsky, 1992) exist that examined students with learning disabilities (LD) and note-taking; however, these studies dealt with college students. Yet, these studies illustrate students’ difficulties and approaches to note-taking. In one study, Suritsky (1992) interviewed students with LD to see how they approach note-taking in college lectures. In this study 31 college students with LD (i.e., as determined by a severe discrepancy between achievement and ability scores) were interviewed on several areas of lecture learning and note-taking. The three main areas reported in her study are: difficulties encountered when taking notes, current note-taking approaches, and suggestions for improving college lectures. In the first area, Suritsky reported that the top four most common problems that students with LD encounter when taking notes during lectures are: writing fast enough to keep up with the lecturer, being able to pay attention, making sense out of notes after the lecture, and deciding what important lecture information to record. In the second area, Suritsky reported that students’ top note-taking approaches during lectures are highlighting important information and trying to keep up with note-taking, and after lectures they are borrowing a classmate’s notes (i.e., to fill in gaps in their own notes) and using the textbook to clarify lecture content. Finally, students were asked to suggest ways that professors could improve lectures. Students’ top recommendations include: providing lecture handouts or outlines, decreasing presentation rates, and identifying which lecture points are important. This study illustrates that college students with LD are cognizant of their note-taking problems, often use inefficient note-taking strategies as they take notes (i.e., an efficient strategy would be to use abbreviations while taking notes), and would like college professors to modify their lectures (i.e., decrease the rate of presentation) and provide lecture notes or handouts for them. Interestingly, these students seem to be aware that their notes are either incomplete or inaccurate because 71% of college students with LD reported that they revise their notes after the lecture (Suritsky, 1992).

While the aforementioned study illustrates the problems reported by college students with LD on note-taking, no studies have empirically reported on individual learning differences between school-age students with and without disabilities during lecture learning and note-taking. Two related studies (Ward-Lonergan, Lillies, & Anderson, 1998, 1999) have empirically examined the effects of student learning during lectures. Although student note-taking was not involved, these studies illustrate the learning problems that students with LD encounter during lectures. In the first study, Ward-Lonergan et al. (1998) compared the performance of middle school students with language-learning disabilities (LLD) and students with no learning disabilities (NLD) who watched two lectures (i.e., comparison vs. causation) on social studies. In their investigation, 20 students with LLD and 29 students with NLD, ages 12 to 14 years old, participated in the study. All students were in seventh grade and English was their native language. Students with LLD met the criteria of having both a language disorder and a learning disability and, as such, were receiving special education services for both their language disorder and learning disability. Students with NLD had average intelligence based upon academic records and achievement test scores. In this study, students
watched two videotaped lectures and then answered inferential and literal comprehension questions. Each videotaped lecture was 5 minutes in length, presented in an auditory format (i.e., no notes were written on the board), and its content was drawn and modified from a seventh-grade social studies textbook to represent fictitious content. During the first videotaped lecture, students watched either a comparison or causation social studies lecture and verbally answered 20 literal and 20 inferential comprehension questions as their responses were audiotaped. During the next portion of the session, students viewed the second videotaped lecture (i.e., either a comparison or causation) and answered another set of literal and inferential questions. The results indicated that students with NLD performed significantly better than students with LLD on both types of lectures, regardless of the type of question (i.e., literal vs. inferential questions). Specifically, their results found that the average score for the group with NLD was 10.0 on literal questions (i.e., out of 20 maximum score) and 9.2 on inferential questions (i.e., out of 20 maximum score) and the average score for the students for LLD was 6.0 for the literal questions and 4.9 for the inferential questions.

In a second study, Ward-Lonergan et al. (1999) compared the performance of middle school students with LLD and with NLD who viewed social studies lectures with similar structure (i.e., comparison vs. causation) mentioned in the previous study, but whose content was different. Again, 20 students with LLD and 29 students with NLD, whose ages were 12 to 14 years old and had English as their native language, participated in the study. Similar to the previous study, students with LLD met the criteria of having both a language disorder and a learning disability and were receiving special education services for both their language disorder and learning disability. Like the previous study, students with NLD had average intelligence based upon academic records and achievement test scores. In this particular study, students viewed two lectures and after each 5-minute lecture, verbally retold the content of a lecture while being audiotaped. Students’ retells were then assessed by counting T-units; in particular, the number of T-units, number of subordinate clauses, number of subordinate clauses per T-unit, percentage of lecture components, number of lecture components per T-unit, number of lecture components per second, and number of T-units per second. The results from this study indicated that students with NLD recalled significantly more information on all of the measures in terms of linguistic productivity (number of T-units, number of subordinate clauses, and percentage of lecture points), syntactic complexity (number of subordinate clauses per T-unit), and efficiency (number of T-units per second, number of lecture components per T-unit, and number of lecture components per second). Specifically, their results showed that students with NLD differed from students with LLD on the number of T-units recalled (NLD = 11.9 vs. LLD = 7.5), number of subordinate clauses recalled (NLD = 3.3 vs. LLD = 1.28), and percentage of lecture components recalled (NLD = 14% vs. LLD = 9%).

In summary, middle school students with LLD who watched and listened to videotaped lectures performed worse on measures of comprehension when compared to non-disabled students. Moreover, it appears that regardless of the structure of the lecture (i.e., comparison vs. causation) or type of comprehension questions, students with LLD performed more poorly than students without disabilities. While these studies compared the performance of students with LD and with NLD who viewed videotaped lectures, it is important to keep in mind that the lectures were short (i.e., approximately 5 minutes) in length and students did not record notes of any kind.

Finally, one study examined note-taking and college students with LD. Hughes and Suritsky (1994) compared how college students with and without learning disabilities recorded notes during a lecture. In their study, 30 college students with LD and 30 college students with NLD served as participants. Those students with LD had problems in written language, reading, or math, and of those with LD, 15 were receiving services through the university’s LD program. The 30 students with NLD were enrolled at the same university and served as a comparison group. This study used a 20-minute videotaped lecture on models of the memory system that was derived from content from a psychology course. Students viewed the lecture and took notes as they normally would in class. Upon completion of the lecture, students’ notes were collected and analyzed in terms of the percentage of cued information units (CIU), percentage of noncued information units (NCIU), and percentage of total information units (TIU). These information units were defined as complete ideas or blocks of information, such as a sentence, sentence clause, or phrase. Students’ notes were also analyzed in terms of the total number of abbreviations (AB) and total number of different words abbreviated (WAB). Their results showed that college students with LD who viewed a videotaped lecture while recording notes recorded fewer CIUs, fewer NCIUs, and TIUs. Specifically, college students with LD only recorded 36% of cued lecture points compared with student with NLD who recorded 56% of the lecturer’s notes. Furthermore, students with LD recorded 50% of overall lecture information units compared to 60% for NLD students. In addition, the researchers’ analysis of students’ use of abbreviations in notes found that college students with LD used fewer total abbreviations, only 19, and fewer abbreviations of different words, 11, compared to NLD students who used 34 total abbreviations and 18 abbreviations of different words. Results from this study confirmed that the performance of students with LD on all of the measures was inferior to the performance of college students without disabilities.

In summary, college students with LD performed significantly worse than college students with NLD on measures of cued lecture points, noncued lecture points, and total lecture
points recorded in their notes. This illustrates the difficulty that college students with LD have with lectures and recording notes; however, to date no studies have examined how younger students (i.e., K–12) with LD record notes and its effects on learning when compared to peers without disabilities.

Given the paucity of literature on the note-taking skills of school-age students with LD, the current study sought to compare and analyze the note-taking and comprehension skills of middle school students with LD as they viewed a videotaped science lecture in comparison to the note-taking and comprehension skills of average achieving classmates. Note-taking is a complex task that involves listening to the lecture, processing the information, and deciding which information is important enough to record. Because note-taking skills are so critical in today’s content-area classrooms, such as science, it is important for researchers to understand how well middle school students with LD record notes from lectures and their subsequent performance on comprehension measures. Specifically, this study sought to determine how students with LD differ from students with NLD on measures of recorded cued lecture points (CLP), uncued lecture points (NCLP), total lecture points (TLP), and total words (TW) recorded. Moreover, this study sought to examine the relationship between students’ notes and test score (TS).

Method

Participants and Setting

The sample consisted of 90 middle school students, 45 of whom were categorized as LD and 45 of whom were students with NLD. This group consisted of 46 girls and 44 boys, age range from 11.7 to 15.2, and composition was 64.4% European American, 18.9% Hispanic American, 14.4% African American, and 2.2% Asian American. The participants were drawn from seven science classes at two different middle schools, and all of the students were in Grades 6, 7, or 8.

Students identified as having a specific learning disability were determined eligible by their respective school districts through testing that used severe discrepancy methodology (i.e., intelligence and academic achievement). Each district’s eligibility policies closely followed state and federal guidelines. Using the state definition of LD, students were required to have an average IQ score and difficulties in one or more of the following areas: oral expression, listening comprehension, written expression, basic reading skill, reading fluency skills, reading comprehension, mathematics problem solving. Students with LD in this study were assessed on IQ using either Wechsler Intelligence Scale for Children III or IV (WISC-III or WISC-IV; Wechsler, 1991, 2003) and their achievement was assessed using the Woodcock–Johnson Tests of Achievement III (Woodcock, McGrew, & Mather, 2001) or Wechsler Individual Achievement Test–II (Wechsler, 2001). On IQ tests (e.g., WISC-III or WISC-IV), the mean full scale standard score was 99.7 (range = 80–127). On the achievement tests, the average standard score in reading was 93.5 (range = 67–114), the average standard score in written language was 97.9 (range = 69–133), and the average standard score in mathematics was 91.8 (range = 66–107). None of the students had any reported history in their records of hearing impairments, visual impairments, physical impairments, or emotional disorders.

Students identified as having NLD had average intelligence based upon academic records and achievement test scores. These students were nominated by their teachers on the basis of the student having no identified disability; passing grades of A, B, or C in science classes; and a passing score of at least 200 (i.e., proficient or advanced) from the state’s most recent assessment in science.

To determine whether both groups were equivalent on writing speed, the investigator administered a 3-minute writing task to assess how fast they could write with little or no mental effort (Hughes & Suritsky, 1994). This brief assessment has been used in other studies (Hughes & Suritsky, 1994; J. R. Boyle & Weishaar, 2001; Lee, Lan, Hamman, & Hendricks, 2007) and is similar to other 3-minute writing tasks that serve as a measure of writing speed (Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002). Letters-per-minute probes have been associated with writing proficiency in the past (Marston, 1989) and have been suggested as one measure of writing fluency (Howell & Nolet, 2000). In fact, Peverly (2006) claims that among students with fast handwriting speed, the load on working memory lessens, thereby enabling them to focus on other aspects of writing and note-taking. During this 3-minute writing task, students were asked to write their first name continuously until told to stop. After 3 minutes, the investigator told them to stop and put their pencils down. Each student’s paper was collected and then assessed by counting the number of letters written per minute. When both groups (i.e., students with LD and NLD) were analyzed, a t test revealed no significant differences between them. Moreover, the average handwriting speed of students with LD and with NLD in this study was similar to other studies that assessed handwriting speed of middle school students with NLD (Graham, Berninger, Weintraub, & Schafer, 1998; Graham, Weintraub, & Berninger, 2001).

The students in this study attended one of two middle schools (each school with approximately 537 and 625 students) located near a large metropolitan city in the Mid-Atlantic region of the country. All of the students were enrolled in middle school science classes and the research took place in these classes with both the regular education teacher and special education teacher present in the room. The teachers did not participate in any component of the study, rather the investigator carried out all of the data collection throughout the study.
Materials

A videotaped lecture was used in this study to control for extraneous variables (e.g., pacing, intonation, pauses) that might have occurred had the lecture been presented “live” to multiple groups of students. The videotaped lecture was presented to students on a 25-inch color television monitor. Because the focus of the lecture was science, the topic was drawn from a *Scientific American* article titled “New Dawn for Electric Rockets.” The content of the lecture described the use of electric plasma engines in spacecraft, how plasma engines compare to conventional chemical fuel, the advantages of plasma engines, and the different types of plasma propulsion systems. This content was selected on the presumption that the information would not be familiar to the participants because it is not a learning standard listed in the state standards and science teachers whose students participated in the study confirmed this presumption. The videotaped lecture was 19 minutes in length and was presented at an average rate of 109 words per minute (WPM). This rate falls within the middle range of “rates of presentation” in videotaped lectures that have been used in past research: 75 WPM (Bretzing, Kulhavy, & Caterino, 1987), 100 WPM (DIVesta & Gray, 1973), 108 WPM (Suritsky & Hughes, 1996), 110 WPM (J. R. Boyle & Weishaar, 2001), 120 and 122 WPM (Titsworth, 2004), and 133 WPM (Ward-Lonergan et al., 1998, 1999).

The videotaped lecture simulated a typical science lecture in that it was auditory in nature, with only the title of the lecture (i.e., “Electric Plasma Rockets and Vesta and Ceres”) written on the board. The lecture was read from a script that contained two types of lecture cues: emphasis cues and organizational cues (Hughes & Suritsky, 1994; Scerbo, Warm, Dember, & Grasha, 1997; Titsworth & Kiewra, 2004). The first type of cue, an emphasis cue (e.g., “It is important to remember . . .”), preceded an important lecture point and served to alert student to this information. The second type of cue, an organizational cue (e.g., “There are three kinds of plasma rocket engines . . .”), served as a framework upon which students organize lecture details. This particular lecture contained 13 CLP, 65 NCLP, totaling 78 TLP. A number of studies have shown that when cues are used in lectures, students with NLD increase their note-taking and subsequent achievement (Maddox & Hoole, 1975; Scerbo et al., 1992; Titsworth, 2004; Titsworth & Kiewra, 2004).

Procedures

During the experimental session, students performed a 3-minute writing task, watched the videotaped lecture while recording notes, and took a 10-point quiz. The entire session took 45 to 50 minutes each. In each classroom at the start of the session, students were informed that they would be watching a videotaped lecture and that they should take notes on it. First students completed the 3-minute writing task. Next, students were told that they would be watching a 19-minute, videotaped lecture titled “Electric Plasma Rockets and Vesta and Ceres” and that they should record as many notes as they could throughout the entire videotaped lecture. There was no mention about the CLP or NCLP in the lecture. All students were supplied with three sheets of lined paper and were asked to write their name and date on each page. Students were told to listen to the lecture and record notes. Immediately following the lecture, students’ notes were collected so that they could not review them or refer to them as they took the 10-question test. The test was distributed to them and when students completed the test, they were asked to remain quiet until the session ended. The test was then collected and scored.

Dependent Variables

In this study, students’ notes were analyzed on four variables: CLP, NCLP, TLP, TW, and TS. Students’ notes examined CLP and NCLP based on how many individual lecture points (LP) were present in their notes. These were added together to get the TLP. LP found in notes were defined as complete ideas or blocks of information, such as a sentence, sentence clause, or phrase from the lecture. Assessing notes according to lecture points (or idea units) is a common procedure that has been used in previous research (Brown, 2005; Hughes & Suritsky, 1994; Kiewra, Benton, Kim, Risch, & Christensen, 1995; O’Donnell & Dansereau, 1993; Risch & Kiewra, 1990). Students were awarded one point for each accurate LP. In each case, students’ papers were first assessed for CLP and then assessed a second time for NCLP using the script from the lecture. Students’ notes were also counted for the total number of words present in them. This was done as a measure of productivity and has also been used in past research (Hartley & Marshall, 1974; Boyle & Weishaar, 2001). Finally, student learning was assessed using a 10-point multiple choice test. The test was developed from the content of the lecture, “Electric Plasma Rockets and Vesta and Ceres.” Students’ TS was used to assess how performance would vary between the two groups (LD vs. NLD), even though both groups took notes.

Interobserver Agreement

An independent rater scored all notes (i.e., CLP, NCLP, TLP, and TW) and the test. All of the students’ notes were also rescored by a second rater (i.e., a graduate student in education) in the same manner as the first rater. Interobserver agreement for each measure was assessed by dividing agreements by agreements plus disagreements. Interrater reliability was calculated to be .99 for TW, .96 for CLP, .97 for NCLP, and .99 for TS. Finally, the content of the quiz was confirmed by the second rater when this rater located and found.
the content pertaining to all of the questions and correct answers (i.e., 100%) in the lecture notes of the presenter from the videotape.

Results

Data Analysis

Because more than one dependent variable was used in conjunction with the independent variable, a multivariate analysis of variance (MANOVA) was the preferred data analysis technique (Stevens, 2002). SPSS for Windows was used for the analyses and probability values were set with \( \alpha \) at .05, unless otherwise noted. Students with LD were compared to students with NLD in this analysis using CLP, NCLP, TW, and TS. Using the variables CLP, NCLP, TW, and TS, the analysis yielded statistical significance with Wilks’ \( \Lambda = .57, F(4, 85) = 16.24, p < .001 \), \( \eta^2_p = .43 \). Subsequent univariate tests indicated that there were significant effects between the two groups on all of the variables: CLP, \( F(1, 88) = 28.90, p < .001 \), \( \eta^2_p = .25 \), power = 1.00; NCLP, \( F(1, 88) = 25.08, p < .001 \), \( \eta^2_p = .22 \), power = .99; TW, \( F(1, 88) = 48.27, p < .001 \), \( \eta^2_p = .35 \), power = 1.00; and TS, \( F(1, 88) = 25.03, p < .001 \), \( \eta^2_p = .22 \), power = .99.

Table 1 displays the average scores for both groups on the ANOVAs. As indicated, students with LD recorded 2.33 CLP, less than half as many CLP as students in the NLD group, 5.44. Similarly, students with LD recorded about half as many NCLP, 7.27, as students with NLD, 13.80. Overall, students with LD recorded fewer TW, 57.31, than students with NLD, 130.57, indicating that students with LD only recorded about half as many words as students with NLD. Finally, students with LD performed worse on the test, 47.11, representing a negative 20% difference.

In addition, the analysis yielded large power for all four of the variables, with it ranging from .99 to 1.0, representing high power. Power is an important factor to consider because it represents the probability of correctly rejecting a false hypothesis (Kerlinger, 1986). Similarly, eta squared is also of importance because, taken together with power and sample size, it represents the strength of the proportion of variation explained between the two groups (Keppel, 1991). In the case of MANOVA, partial eta squared is used as an estimate of variance in the dependent variables (Tabachnick & Fidell, 2001) and is equivalent to eta squared when the total sample size is 50 or more (Stevens, 2002). In this analysis, large effect sizes were revealed for the four variables (\( \eta^2_p \) range = .22–.35).

According to Cohen (1977), \( \eta^2_p \) coefficients of .14 or larger represent a large effect size.

Overall, students with LD performed more poorly than students with NLD in terms of lecture points recorded in their notes (see Figure 1). In terms of the overall number of notes recorded, when compared to the lecture notes of the presenter, students with LD only recorded an average of 13% of the TLP, compared to students with NLD who recorded, on average, 25% of the TLP. While not as prolific as older students (i.e., studies that examined notes of college students), the total percentage of lecture points recorded by middle school students with NLD in this study were within the range of previous research. For example, Kiewra and colleagues reported that college students with NLD recorded on average 42% of the total lecture points in one study (Kiewra et al., 1995), 35% in another study (Kiewra, DuBois, Christensen, Kim, & Lindberg, 1989), and 32% a third study (Kiewra et al., 1991). Among middle school students with NLD, studies report that they typically record, on average, only 27% (Risch & Kiewra, 1990) or 25% of the total notes (O’Donnell & Dansereau, 1993) from lectures.

Finally, correlations between students’ notes and the test scores were calculated to examine the relationship between types of notes recorded (e.g., CLP, NCLP, TW) and test performance (see Table 2). All of these variables were significant at the .01 level. As shown, each variable had a positive moderate correlation, with CLP (\( r = .53, p < .001 \)) having the strongest relationship between type of notes that students recorded and test performance.
notes on tests of recall and recognition.

Risch and Kiewra (1990) found that middle school students with NLD who recorded significantly fewer notes in previous research among students with NLD (Titsworth, 2004) had subsequent detrimental effects on test performance, as reflected in their group average of 47%, compared to the test performance of their peers with NLD, who averaged 67%. For students with LD, deficits in their note-taking had subsequent detrimental effects on test performance, inhibiting irrelevant lecture points (i.e., deciding which notes are important to record and they have a difficult time writing fast enough to keep up with the speaker.

According to researchers (Kobayashi, 2005; Peverly, 2006; Peverly et al., 2007) note-taking represents a complex and cognitively demanding task. Note-taking involves listening to the lecture, holding this information in working memory (WM) while deciding which important lecture points are worth recording, selecting or creating lecture points to record from WM, and writing them quickly while simultaneously listening to new lecture content. All of this must occur rather quickly and efficiently or information in WM will be lost to decay or incoming lecture information. Students must not only have good listening skills, but they must be able to use selective attention to choose important points from the lecture, write the information in notes so that it is understandable (i.e., useful to the note-taker), and write quickly enough to be able to keep up with the lecturer. According to previous research, writing fluency (i.e., letter fluency) was a consistent predictor of the quality of students' notes (i.e., who record notes while listening to a lecture; Peverly et al., 2007). Incorporating information from this study and previous studies with WM theory indicates that: (a) Students who are fluent writers have more capacity in WM for higher level processing of lecture information (Peverly, 2006); (b) students must have sufficient cognitive resources and abilities (i.e., strategies for listening, dictation, and writing) to interpret, process, and translate incoming lecture information into notes (Altemeier, Jones, Abbott, & Berninger, 2006); and (c) executive functions in students appears to play a major role at switching attention back and forth from listening to the speaker to writing down notes, inhibiting irrelevant lecture points (i.e., deciding which lecture points are relevant to record and which are irrelevant), and activating long-term memory (LTM) to move ideas from

**Table 2. Correlation Between Lecture Points, Total Words, and Test Score**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Test: Pearson’s r</th>
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<tbody>
<tr>
<td>Cued lecture points and test score</td>
<td>.53</td>
</tr>
<tr>
<td>Noncued lecture points and test score</td>
<td>.39</td>
</tr>
<tr>
<td>Total lecture points and test score</td>
<td>.48</td>
</tr>
<tr>
<td>Total words and test score</td>
<td>.47</td>
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</tbody>
</table>

**Discussion**

The present study represents the first to illustrate the extent to which middle school students with LD have difficulty taking notes when compared to students with NLD. Specifically, this study shows that students with LD recorded fewer notes during a lecture (13% of TLP for LD compared to 24% for NLD). Even when teacher cues are provided, students with LD underperformed compared to their peers with NLD. Students with LD only recorded 18% of the total CLP (i.e., when compared with the total possible CLP from lecture notes) in contrast to students with NLD who recorded 42% of the total CLP. Comparable differences were also observed in the percentage of NCLP, as students with LD recorded only 11% of the overall possible NCLP—compared to 21% for students with NLD. Finally, overall differences were noted in the number of words recorded in their notes, as students with LD recorded 58 words, compared to 131 words recorded by students with NLD. For students with LD, deficits in their note-taking had subsequent detrimental effects on test performance, as reflected in their group average of 47%, compared to the test performance of their peers with NLD, who averaged 67%.

The results from the current study confirm and extend the research base on note-taking among students with LD. In a prior study by Hughes and Suritsky (1994), researchers found that college students with LD took fewer notes (i.e., 36% vs. 56%, respectively) when compared to their NLD peers and recorded fewer CLP (i.e., 46% vs. 77%, respectively). Similarly, the results from the current study found that not only do middle school students with LD have a difficult time determining important lecture points (i.e., CLP), but they also have a difficult time recording additional lecture points, as evidenced by the low number of NCLP and overall fewer TW in notes. Moreover, the current study expands the research about the effects of recording fewer notes during a lecture on test performance. As shown in this study, students with LD recorded fewer notes and subsequently performed poorly on the test (i.e., 47% for LD group and 67% for NLD group). This association has been noted in previous research among students with NLD (Titsworth, 2004; Titsworth & Kiewra, 2004). In particular, a study by Risch and Kiewra (1990) found that middle school students with NLD who recorded more notes (i.e., ideas and words in notes) outperformed students who recorded significantly fewer notes on tests of recall and recognition.

In addition to student performance on measures, the results from the analysis of correlation found that students’ notes were moderately correlated with students’ test score, with cued notes have the highest correlation (i.e., .53). This finding is similar in size with previous research that found significant correlations, ranging from .42 to .53, between college students’ general notes and recall and comprehension tests (Fishcher & Harris, 1973). Likewise, Titsworth (2004) found an average correlation of .53 between cued lecture points in college students’ notes and different recall measures.

In terms of poor note-taking skills, this study illustrates the extent of the problems that middle school students with LD have compared to nondisabled peers. First, students with LD failed to record as many important lecture points as peers (i.e., they only recorded about half as many CLP). Second, students failed to record as many noncued lecture points, sometimes referred to as note details (Titsworth & Kiewra, 2004), as peers (i.e., again they only recorded about half as much). The results from this study support comments made by students with LD (Suritsky, 1992) that they have a difficult time deciding which notes are important to record and they have a difficult time writing fast enough to keep up with the speaker.
LTM to WM as they relate to incoming lecture points (Altemeier et al., 2006; Berninger, Neilsen, Abbott, Wijisman, & Raskind, 2008; Berninger, Raskind, Richards, Abbott, & Stock, 2008; Swanson, Zheng, & Jerman, 2009).

Moreover, excessive WM load has been implicated as one main culprit for students’ with LD ability to effectively record notes from lectures (Gathercole, Lamont, & Alloway, 2006; Peverly, 2006) and that reducing the load on working memory through the use of supports can aid student learning (Gathercole, Durling, Evans, Jeffcock, & Stone, 2007). Various supports have been developed that can assist students with LD learn during lectures, among these are strategic note-taking (Boyle & Weishaar, 2001) and guided notes (Hamilton, Seibert, Gardner, & Talbert-Johnson, 2000; Lazarus, 1991, 1993). The training usually involves teaching students how to use structured or cued note-taking paper. Results from these studies have illustrated that once students are taught to use a note-taking technique, notes improve, as well as comprehension. This increase is often reflective of a reduced load on WM, particularly verbal WM, as well as increased attention directed toward the important aspects of the lecture (Altemeier et al., 2006; Berninger, Neilsen, et al., 2008).

Furthermore, effective note-taking techniques should help students capture the majority of the critical ideas in a lecture, portray the nature of the relationships among those ideas, and identify appropriate connections between these ideas and a student’s prior knowledge of the lecture topic (Kiewra, 1991). Teachers can assist in this process by presenting crucial information (i.e., those important lecture points) in a clearly organized manner. Simply organizing lecture content helps students to record more organized notes and in greater quantity (Howe, 1977; Schultz & DiVesta, 1972). Teachers can also use a variety of cues to draw attention to the important aspects of the lecture and this in turn will help students record more notes. For example, simply writing important lecture points on the board can increase the likelihood that the same information will be found in students’ notes. In one study, students recorded up to 88% of the lecture information when lecture points were also written on the board (Locke, 1977). Also as discussed earlier, because students with LD tend to record more cued lecture points than noncued points (Hughes & Suritsky, 1994), teachers should use lecture cues to ensure that students record those “essential” lecture points. Previous research has shown that cued lecture points result in students recording a greater number of notes and higher achievement on recall measures (Titusworth, 2004; Titusworth & Kiewra, 2004).

In terms of helping students record more notes when the lecture moves at a fast pace, teachers can use abbreviations and teach students how to use abbreviations (Hughes & Suritsky, 1994). Also, slowing down the pace of the lecture through the use of pauses will aid students in recording more notes. For example, research has shown that when 2-minute pauses (i.e., through use of the pause procedure) are periodically placed in lectures, students can discuss their notes, fill in gaps in their notes, and in the process, record more notes (Ruhl, Hughes, & Gajar, 1990; Ruhl, Hughes, & Schloss, 1987; Ruhl & Suritsky, 1995). Finally, reviewing notes immediately after recording them has been shown to increase comprehension of lecture information. For example, Lazarus (1991) used a review period following student use of guided notes. This condition produced the greatest gains on measures of comprehension of the lecture. Despite the type of procedure used, research has shown that reviewing notes results in greater gains (Hartley, 1983; Kiewra, 1985).

Interpreting the result of the current study, the reader should take into consideration its limitations. First, the study only used one videotaped lecture to determine difference between middle school students with LD and NLD. Future studies should examine multiple lectures from a number of different science topics. Second, this study used a videotaped lecture as opposed to using live lectures. While the videotaped lecture allowed for the controlling of extraneous variables, it was still a contrived lecture that did not allow for interaction as is typically found in middle school science classrooms. Furthermore, since teachers present lectures in different delivery formats, it is entirely possible that the videotaped lecture was less “teacher-friendly” than most lectures that are presented in middle school science classrooms. Third, students were informed that their notes or the test would not be used in any way toward students’ grades. It is possible that students may not have been motivated to record “generative” notes that would have aided their performance on the actual notes that were recorded or performance on the test (Slotte & Lonka, 2001).

Future research should explore more detailed learning differences between middle school students with LD and NLD in terms of delayed recall tests, writing tasks, and lecture cues. First, since in typical classrooms tests occur several days or weeks after the lecture, future research should examine student performance on delayed tests to see if the effects would be different on performance. Second, future research should examine how students with LD perform on various listening and writing tasks (e.g., essay writing, dictation, spelling) to compare their performance on these tasks with their lecture notes. Using various writing tasks might reveal whether there is a strong relationship between certain aspects of writing and note-taking. This information might aid future researchers who develop note-taking training for students with LD. Finally, future research should examine the effects of various types of lecture cues (i.e., written vs. verbal cues) to see which type of cues might be the most effective for student note-taking. As a precursor for this research, it might be interesting to sample middle school teachers to what types of lecture cues or prompts they use in their actual classrooms to elicit students to record important lecture points. Specifically, it would be

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interesting to examine what are the most common verbal lecture cues (e.g., this is important to remember, this is critical to know, you should write this down) that middle school teachers use to ensure that certain lecture points are recorded by their students. It might then be possible to use these lecture cues when training students with LD to record better notes.

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About the Author

**Joseph R. Boyle**, PhD, is an Associate Professor in the Graduate School of Education at Rutgers, The State University of New Jersey. His research interests include teaching techniques in the areas of reading, writing, and note-taking for students with mild disabilities.