Strategic Note-Taking for Inclusive Middle School Science Classrooms
Joseph R. Boyle
Remedial and Special Education published online 27 June 2011
DOI: 10.1177/0741932511410862

The online version of this article can be found at:
http://rse.sagepub.com/content/early/2011/06/24/0741932511410862

Published by:
Hammill Institute on Disabilities

http://www.sagepublications.com

Additional services and information for Remedial and Special Education can be found at:

Email Alerts: http://rse.sagepub.com/cgi/alerts
Subscriptions: http://rse.sagepub.com/subscriptions
Reprints: http://www.sagepub.com/journalsReprints.nav
Permissions: http://www.sagepub.com/journalsPermissions.nav
Strategic Note-Taking for Inclusive Middle School Science Classrooms

Joseph R. Boyle

Abstract
To be successful in inclusive classrooms, middle school students need effective note-taking skills to learn lecture content. Unfortunately, students with disabilities perform poorly at recording critical lecture content in notes and perform poorly on subsequent tests. Therefore, the purpose of this study was to assess the effects of a note-taking technique, called strategic note-taking, on the note-taking and achievement of students with and without learning disabilities. The results showed that students who were trained to use strategic note-taking performed better than students who used conventional note-taking on measures of immediate recall and comprehension. The limitations of the research and the implications for future research are discussed.

Keywords
learning disabilities, note-taking, science, middle school

Since its inception, the intent of PL 94-142, now the Individuals with Disabilities Education Act 2004 (IDEA, 2004), was to provide students with disabilities with equal learning opportunities in schools and to educate them alongside their peers without disabilities to the maximum extent appropriate (Mead & Paige, 2008). The percentage of students with disabilities who receive most of their education in general education or inclusive classrooms has continued to rise from 33% in the early 1990s to most recently 52% (Sack, 1998; U.S. Department of Education, 2009). This trend is anticipated to continue, if not accelerate, because of recent changes to IDEA 2004 and the No Child Left Behind (NCLB) Act of 2001. These Acts require students with disabilities to have access to the general education curriculum and require schools to be held accountable to higher standards for the performance of all students (i.e., both those with and without disabilities) (West & Whitby, 2008). Likewise, as reflected in surveys, the majority of special education teachers feel that students with disabilities are now in a curriculum that is more demanding and more similar to the curriculum used for general education students than ever before (Olson, 2004, p. 16). Finally, because state tests are now linked to end-of-the-course and exit requirements for students graduating with a diploma, access to and even more importantly, active participation in the general education curriculum has become the critical element for students with disabilities as they strive to become equal partners in the learning process in inclusive classrooms (DeSimone & Parmar, 2006).

Once in inclusive classrooms, students with disabilities must not only learn the same content but are expected to keep up with the assignments and grading expectations of the class (Schumm et al., 1995). For example, the National Longitudinal Transition Study–2 (NLTS2) revealed that 99% of general education teachers felt that students with learning disabilities (LD) who are in their classrooms are expected to keep up with other students in the class, yet the same teachers reported that only 78% of these students actually do keep up (Newman, 2006). In content-area classes such as science, where teachers use a variety of instructional approaches (i.e., guided inquiry, problem-based learning, peer tutoring) to present content to students (Scruggs, Mastropieri, Berkeley, & Graetz, 2010; Scruggs, Mastropieri, & Okolo, 2008), whole-class, teacher-led lecture learning is still the dominant form of instruction (Scruggs, Mastropieri, & McDuffie, 2007). A recent investigation by Vogler (2006) found that 79% of content-area teachers reported that they regularly use or mostly use lectures during their teaching. Likewise, Putnam, Deshler, and Schumaker (1993) reported that middle school science

1The State University of New Jersey, New Brunswick

Corresponding Author:
Joseph R. Boyle, Graduate School of Education (Rm 323), Rutgers, The State University of New Jersey, 10 Seminary Place, New Brunswick, NJ 08901-1183
Email: joseph.boyle@gse.rutgers.edu
teachers devote an average of 44% of each class period to teacher lectures.

Moreover, in many content-area classrooms, such as science, textbooks are often used to drive the content that is taught in courses (Cawley & Parmar, 2001; Harniss, Dickson, Kinder, & Hollenbeck, 2001). When teachers derive lecture content from textbooks, the result are lectures that contain vast amounts of information, mostly in the form of concepts, facts, and abstract vocabulary (Cawley, Hayden, Cade, & Kroczyński, 2002). In response to teaching the mandated curriculum in preparation for state tests, content-area teachers often have to move at a rapid pace during lectures and lessons to cover large quantities of content (Deshler, Schumaker, Bui, & Vernon, 2006; Mastropieri & Scruggs, 2001) and often feel pressure to cover all of the curriculum, even though some students have not yet mastered certain components of it (DeSimone & Parmar, 2006; Mastropieri & Scruggs, 2001).

For middle school students to keep up in these classes, the bottom line is that they must be able to record notes from lectures that move at quick pace (Harniss et al., 2001; Scruggs et al., 2007; Scruggs, et al., 2008). For students with LD, recording notes during a lecture can become an overwhelming task because of the intense cognitive demands associated with note-taking during lectures (Peverly, 2006), as well as the temporal demands involved in recording lecture notes. Unlike other academic tasks (e.g., reading a book or writing an essay), students cannot slow down when recording notes or they will lose lecture information already in working memory and will miss subsequent lecture points spoken by the teacher (Piolat, Olive, & Kellogg, 2005). Lacking effective note-taking skills very often means that students will miss important lecture content (Boyle, 2010; Stringfellow & Miller, 2005) that may negatively affect grades (Deshler et al., 2006). In fact, teachers have reported that their lectures were the major source of information for developing classroom tests (Putnam et al., 1993) and that test scores represent half of a student’s grade for the marking period (Putnam, 1992).

Despite the importance of being able to record notes effectively in content-area classes, when left to their own devices, students with LD and with no learning disabilities (NLD) are poor note-takers in terms of recording critical lecture information. Studies have shown that K–12 students with NLD record about only 25% to 27% (Boyle, 2010; Risch & Kiewra, 1990) and middle school students with LD record only 13% of science lecture information (Boyle, 2010). Furthermore, even when provided with cued lecture points (CLP; i.e., emphasis and organizational cues) throughout the lecture, students with LD still record fewer of these CLP (i.e., only 43% of CLP; Boyle, 2010). Recording cued notes is important for students because teachers often use emphasis cues (e.g., “You should remember that . . .”) immediately preceding a salient lecture point to call attention to its importance. A second type of cued lecture point, an organizational cue (e.g., “There are six adaptation strategies . . .”) is also used by teachers to help students organize lecture content by providing a framework for subsequent lecture points, as well as to help them discern important from less important lecture content (Titsworth, 2001a, 2001b). In addition, CLP has been found to be moderately correlated (i.e., .53) with students’ test performance (Boyle, 2010). Regardless of the type of lecture cue (i.e., emphasis or organizational), these cues serve to increase the amount of notes that students record and ultimately increase their achievement on comprehension and recall measures (Titsworth, 2001a, 2001b; Titchworh & Kiewra, 2004).

Of the note-taking techniques relevant for school-age students (i.e., K–12) with disabilities for use during classroom lectures, only two research-based note-taking techniques are available in the literature: guided notes and strategic note-taking. Guided notes represent an effective technique that has been used for students with disabilities (Lazarus, 1991, 1993; Patterson, 2005; Sweeney et al., 1999) in K–12 school settings during lectures. The majority of the studies found that once K–12 school students with mild disabilities were trained to use guided notes, they made gains on tests (e.g., over baseline periods). The second note-taking technique, strategic note-taking, has been found to be effective for high school students with mild disabilities (Boyle & Weishaar, 2001). When high school students with mild disabilities used strategic note-taking to record notes during lectures, researchers (Boyle & Weishaar, 2001) found that trained students outperformed control subjects who used conventional note-taking techniques on recall measures, test performance, and total number of words in recorded notes. Despite the promise of these techniques, neither has been used with middle school students with and without disabilities who participate in inclusive science classes.

Although guided notes are effective for students with disabilities, strategic note-taking offers two advantages over guided notes for students during lectures. First, preparing guided notes by reviewing the content of the lecture and then transcribing it in guided-note form for students is a very time-intensive process for teachers (e.g., Lazarus, 1993, reports that 18 to 25 pages of guided notes were developed for just one chapter). The fact is that general education science teachers have to cover vast quantities of information at a sufficiently quick pace (Deshler et al., 2006; Schumm et al., 1995) and are often reluctant to make changes in their teaching or presentation mode for students with mild disabilities (McIntosh, Vaughan, Schumm, Haager, & Lee, 1993; Schumm & Vaughan, 1991). This reduces the probability that these teachers will be able to find the time to make and use adaptations, such as guided notes, for students with disabilities. Second, strategic note-taking offers students with disabilities a chance to learn effective note-taking skills that they could use independent of teacher assistance and, once mastered, these skills could be used...
by students as they move on to high school and postsecondary settings (i.e., college). Initially strategic note-taking would require some time to teach (e.g., typically two class sessions). However, in the long run strategic note-taking would make students more independent learners, would not require general education teachers to make many adjustments in their lecture style or teaching, and would not add additional preparation to their workload. Finally, in terms of practicality and potential, strategic note-taking is a low-cost (paper and pencil), highly beneficial technique that could be used to improve the note-taking skills of students with disabilities in science classes.

Given the paucity of literature on research-based note-taking techniques for school-age students with LD and NLD to use in inclusive classrooms, the current study was designed to extend the research by assessing the effects of strategic note-taking for middle school students with LD and NLD in science. Specifically, this study sought to address the following research questions pertaining to the effectiveness of strategic note-taking among students with LD and NLD:

1. Would students who used strategic note-taking record more total lecture points than students in the control group?
2. Would students who used strategic note-taking recall more cued lecture points in notes than students in the control group?
3. Would students who used strategic note-taking record more vocabulary words than students in the control group?
4. Would students who used strategic note-taking record more overall notes, in terms of words recorded, than students in the control group?
5. Would students who used strategic note-taking perform better on the achievement measures of immediate and long-term free recall measures and a comprehension test than students in the control group?

Method

Participants

A total of 104 students in the sixth, seventh, and eighth grades participated in the study, with 28 identified as having LD and 76 with NLD (see Table 1). The participants, whose ages ranged from 11.7 to 15.3, were drawn from seven science classes at two different middle schools located in New Jersey. All students with LD at both middle schools participated in inclusive science classes. The ethnic make-up of the entire sample was 62.5% European American, 20.2% Hispanic American, 11.5% African American, 3.8% Asian American, and 1.9% other ethnicity. All of the students identified with 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) and closely followed state and federal guidelines. On IQ tests (e.g., Wechsler Intelligence Scale for Children III or IV), the mean full-scale standard score for the group was 101.3 (range = 76–127). On the achievement tests (Woodcock Johnson Tests of Achievement III or Wechsler Individual Achievement Test-II), the average standard score in reading was 94.2 (range = 74–107) and the average standard score in written language was 97.1 (range = 69–111).

Pearson’s chi-square analyses were conducted to determine whether the experimental and control groups were similar on demographic variables. Results indicated no statistically significant differences between the experimental and control group on gender, \( \chi^2(1, N = 104) = 15, p = .69 \); grade, \( \chi^2(2, N = 104) = 3.38, p = .18 \); or academic rank (i.e., above average, average, below average, LD), \( \chi^2(3, N = 104) = .64, p = .89 \). Because of low cell sizes, chi-square analysis of ethnicity among the two groups was not possible.

Table 1. Student Demographics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Experimental (n = 52)</th>
<th>Control (n = 52)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Female</td>
<td>29</td>
<td>27</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>European American</td>
<td>33</td>
<td>30</td>
</tr>
<tr>
<td>Hispanic American</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>African American</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Asian American</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Grade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>7</td>
<td>19</td>
<td>27</td>
</tr>
<tr>
<td>8</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Academic rank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above average</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td>Average</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Below average</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>LD</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

Note: LD = students with learning disabilities.

Participant Selection Criteria

After obtaining institutional board approval, two schools were selected whose principals had previously agreed to allow the research to take place in their respective schools. Each middle school provided inclusive science classes for all students with LD. The primary investigator, a university professor, attended each school’s faculty meeting and solicited interest among special education teachers and middle school science teachers. From these two meetings, seven
science teachers and six special education teachers agreed to participate in the study, all of whom taught in inclusive science classrooms. These teachers were then provided with parental consent and student assent forms that were sent home with students. After two weeks, only students who returned both the signed forms were permitted to participate in the study.

General Procedures

Students with NLD who agreed to participate were assigned a ranking by their teacher of average (A), above average (AA), or below average (BA), based on grades in science (i.e., A, B, C, or D grade) and scores from the state’s most recent assessment. Once ranked, students were randomly assigned to participate in either the experimental or control group. This ranking was done to ensure that students with differing achievement levels were equally distributed into the experimental and control groups, resulting in the control group being composed of 20 A, 15 AA, and 3 BA students and the experimental group being composed of 20 A, 13 AA, and 5 BA students. Likewise, the 28 students with LD were randomly and equally assigned to either an experimental or control group.

Writing speed was used as a pretreatment measure because letter fluency (i.e., transcription fluency) has been found to be a consistent predictor of quality of notes (Peverly et al., 2007). Writing speed was assessed by administering a 3-min writing sample in which students wrote their first name for 3 min. As used in other studies (Boyle & Weishaar, 2001; Hughes & Suritsky, 1994; Lee, Lan, Hamman, & Henricks, 2007), this type of measure assesses how fast students can write with little or no mental effort (Hughes & Suritsky, 1994) and is considered a measure of writing fluency and proficiency (Gansle, Noell, VanDerHeyden, Naquin, & Slider, 2002). The average writing speed of the participants (i.e., 69 LPM) fell within the reported range (i.e., 57–88 LPM) of writing speed for middle school students from other studies (Hamstra-Bletz, & Blote, 1990; Graham, Weintraub, & Berninger, 1998).

In addition to random sampling of students into control and experimental groups, initial t tests were conducted to ensure that both groups were academically equivalent. The results of the initial analyses found no significant differences between the two groups on the 3-min writing task (i.e., experimental group: $M = 67.44, SD = 17.97$; control group: $M = 70.87, SD = 18.21$), nor were there any significant differences between the two groups of students with LD on their IQ test scores (i.e., experimental group: $M = 97.50, SD = 13.10$; control group: $M = 105.00, SD = 12.64$).

Intervention

The independent variable was strategic note-taking. This strategy was developed to be used in conjunction with the strategic note-taking paper (i.e., cued note paper). Students in the experimental group used strategic note-taking and students in the control group were provided with lined paper and told to record notes as they typically would in class.

Strategic note-taking strategy (SN strategy). The SN strategy CUES was used to assist students at taking notes. In the first step, the Cluster step, students were reminded to record lecture ideas into clusters of three to six related lecture points on the SN paper. The Use step prompted students that teachers use lecture cues (i.e., number cues and importance cues) during the lecture and on hearing these cues, record lecture points that were associated with the cues. In the Enter step, students entered vocabulary words in the appropriate section of the SN paper. In the Summarize step, after students clustered three to six ideas, they were told to write a summary word or words that would categorize the clustered ideas.

Strategic note-taking paper (SN paper). The SN paper (because of space constraints, an abbreviated version is presented in Figure 1) was developed based on Mayer’s SOI Model of Learning (Mayer, 1996), as well as other research on generative note-taking (Peper & Mayer, 1986). At the top of the SN paper, students would quickly identify the lecture topic and relate the topic to their own background knowledge of it. In doing so, students were able to make connections between new and previously learned information, making the new information more meaningful (Peper & Mayer, 1986). In the next portion of the SN paper, students clustered together three to six main points with details from the lecture, as they were being discussed in the videotaped lecture. Next, students summarize (or categorize) clustered ideas. If there were any new vocabulary or terms, students would also list these in the appropriate section of the SN paper. The steps of naming three to six main points, summarizing immediately after naming lecture points, and listing new vocabulary or terms were repeated on additional pages until the lecture ended. The last page directed students to write five main points from the lecture with descriptions of each.

Materials

Two videotaped lectures were used in this study, one for training (i.e., Frogs and Toads) and the other for the testing session (i.e., Crash Test Dummies). Videotaped lectures offered several advantages over live lectures. The videotaped lecture for the testing session controlled for extraneous variables (e.g., pacing, intonation, pauses) that might have occurred had the lecture been presented live to multiple groups of students and the videotaped lecture for the training session allowed for a second presentation during the training (i.e., described in the procedures section). In addition, to control for students’ prior knowledge, the topic for the testing session was drawn from a Smithsonian

Downloaded from rse.sagepub.com at RUTGERS UNIV on August 16, 2011
article, “Sitting in Our Stead: Crash Dummies Take the Hard Knocks for All of Us,” by Wolkomir and Trent (1995). It was presumed that students would not be familiar with the content of the lecture because the topic is not a state learning standard and it is not covered as part of the middle school curriculum.

Videotaped lectures were presented to students on a 25-inch color television monitor. The videotaped testing lecture was 17 min in length and was presented at an average rate of 94 words per minutes (WPM). This WPM rate falls within the range of rates of presentation in videotaped lectures that have be used in past research: 75 WPM (Bretzing, Kulhavy, & Caterino, 1987), 100 WPM (DiVesta & Gray, 1972), 100 WPM (Risch & Kiewra, 1990); and 108 WPM (Hughes & Suritsky, 1994). Each lecture was read from a script that contained both CLP and noncued lecture points (NCLP). Each CLP consisted of one of two types: emphasis cue or organizational cue (Hughes & Suritsky, 1994; Scerbo, Warm, Dember, & Grasha, 1992; Titsworth & Kiewra, 2004) and this particular lecture contained 13 CLP and 60 NCLP, totaling 73 TLP (i.e., CLP plus NCLP resulted in TLP).

Training Procedures
The study was conducted over four sessions. During the first two consecutive sessions, experimental group students were trained using the first videotaped lecture (i.e., Frogs and Toads) in a separate location (e.g., library or media room) so as not to expose any control subjects to the intervention. Each training group was composed of 6 to 10 experimental group subjects, resulting in an approximate trainer-to-

Figure 1. Abbreviated version of strategic note-taking paper.
The purpose of this training session was that the videotape was not stopped until the conclusion of the videotaped lecture. During this time, the instructor pointed out to students how he did not record the portion of the lecture, the investigator stopped the tape and explained to students what he had written on the SN paper. At the end of each section, the videotape was stopped, and questions were solicited, and student responses from their recorded notes were discussed. This procedure was repeated until the end of the lecture. The purpose of this training session was to accclimate students with the speed of the lecture and improve their fluency at using strategic note-taking.

**Fidelity**

To ensure fidelity of the training across the seven classes, three procedures were used:

1. The primary investigator followed a scripted lesson that he referred to as he taught SN to different groups of students.
2. Twenty-five important components of the training were outlined and developed into a checklist that the primary investigator checked off as he trained students.
3. An independent rater present for the training also checked off the components as they were taught.

When both forms were compared and tabulated, there was 98% agreement of the components taught.

**Measures**

In this study, the four dependent variables that were used to assess the effectiveness of strategic note-taking were an IFR measure; an LFR measure; a test, resulting in a test score; and students’ notes. Similar measures have been used in the past to assess student’s productivity and performance from lectures (Kiewra, Benton, Kim, Risch, & Christensen, 1995; O’Donnell & Dansereau, 1993; Risch & Kiewra, 1990) and served to assess the effectiveness of strategic note-taking.

**Analysis of measures.** The measures were analyzed in several ways that included vocabulary words (VOC), CLP, TLP, and total words (TW) present in notes; TLP in recall measures; and percentage correct test score (TS). CLP and TLP were based on how many individual lecture points (LP) were present in their notes. CLP and NCLP were added together to get TLP. A similar criterion has been used in past note-taking studies that examined CLP and TLP in students’ notes (Hughes & Suritsky, 1994; Titsworth & Kiewra, 2004). A lecture point was defined as an idea or a block of information from the lecture, with a short clause or phrase accepted as the minimum to be counted as a lecture point. Students’ LP were compared to the script from the lecture and were awarded one point for each accurate lecture point. Previous research (Hughes & Suritsky, 1994; Kiewra et al., 1995; O’Donnell & Dansereau, 1993; Risch & Kiewra, 1990) has used a similar method of assessing LP (or idea units) in notes and other measures. Along with lecture points, productivity was also assessed by counting the total number of words in notes, with similar procedures used in previous research studies (Boyle & Weishaar, 2001; Hartley & Marshall, 1974). To assess comprehension of lecture content, student learning was assessed using a...
15-point multiple-choice test and scores were reported as percent correct. Finally, because vocabulary serves an important role in understanding and comprehending concepts (Gomez & Madda, 2005; Pearson, Hiebert, & Kamil, 2007), 10 key vocabulary words (e.g., transducer, accelerometers, viscous, criterion) were identified from the lecture that students should know in order to understand the content. Students’ notes were analyzed for the presence of these 10 key vocabulary words and were awarded one point for each vocabulary word present in notes. To avoid inflating vocabulary word count, students were only awarded one point per vocabulary word regardless of how many times it appeared in notes, resulting in a maximum score for VOC of 10 points.

**Interrater reliability.** An independent rater (i.e., a graduate student in education) who was unaware which students were in the experimental or control group scored all notes, recall measures, and the test. One third of the students’ notes, recall measures, and tests were also rescored by a second rater in the same manner as the first. Interobserver agreement for each measure was assessed by dividing agreements by agreements plus disagreements.

**Students’ notes.** Immediately after the videotape concluded and students finished recording notes, all students’ notes were collected. An independent rater scored all students’ notes for CLP, TLP, VOC, and TW. Using students’ notes, a second rater randomly selected one third of the notes and scored each in the same manner as the first rater. Interrater reliability for students’ notes was calculated to be .94 for CLP, .94 for VOC, .93 for TLP, and .98 for TW.

**Immediate free recall.** An immediate free recall measure was administered promptly after students viewed the videotape to assess their knowledge about the lecture topic. On completing the videotape, students’ notes were collected and they were told to use the blank paper provided to write down as many facts, vocabulary, and lecture ideas as they could within a 5-min time period. An independent rater scored all IFR measures for TLP. Using the IFR measure, a second rater randomly selected one third of the IFR measures and scored each in the same manner as the first rater. Interrater reliability for IFR was calculated to be .94 for TLP.

**Long-term free recall.** Similar to the IFR measures, an LFR measure was administered to assess long-term knowledge about each lecture topic. Two days after viewing a videotape, students completed an LFR measure. As with the IFR measure, students were instructed to use the blank paper provided to write down as many facts, vocabulary, and lecture ideas as they could within a 5-min time period. Similar to the IFR measure, interrater reliability was also assessed for the LFR measure. After an independent rater scored all of the LFR measures, one third of the randomly selected LFR measures were scored by a second rater, and interrater reliability for LFR was calculated to be .95 for TLP.

**Comprehension test.** Immediately after recording notes, each student was administered a 15-point multiple-choice test that resulted in each student’s test score (TS). The test was developed from the content of the lecture, Crash Test Dummies, and its accuracy was confirmed by the second rater, who confirmed the content and accuracy of the test. Using the script from the lecture, the second rater confirmed that each question was drawn from the content of the lecture and, using the answer key, also confirmed that each answer had been correctly identified (i.e., 100%) in the key. Using the answer key, the independent rater scored each test and one third were rescored by a second rater, which revealed 99% interrater reliability.

**Strategic note-taking student questionnaire.** A student questionnaire was administered to students in the experimental group to determine their likes and dislikes about strategic note-taking. The questionnaire was composed of six statements with a 4-point Likert-type scale rating (1 = strongly disagree to 4 = strongly agree). Specific items explored whether strategic-noting was helpful at recording better notes, remembering lecture information, and improving students’ science grade. In addition, one statement explored whether students preferred strategic note-taking over conventional note-taking and two open-ended questions asked students to identify what they liked and disliked most about strategic note-taking.

**Relationship between dependent variables and strategic note-taking.** To assess the effectiveness of the strategy steps, specific measures were linked to each step. For the Cluster lecture points step, TLP was assessed in students’ notes and recall measures to determine whether SN subjects differed from subjects in the control group. In the Use teacher cues step, CLP were assessed to determine if there were any difference between the SN group and the control group. In the Enter vocabulary step, VOC in notes was assessed to determine if there were any differences between the SN group and the control group. In the Summarize step, TW was used to assess differences between the two groups on the number of words recorded. Finally, to assess the overall effectiveness of the SN strategy on student achievement, TS, IFR, and LFR were used to determine learning differences between the two groups.

**Experimental Design and Data Analysis**

A multivariate analysis of variance (MANOVA) was conducted with two between-subjects factors and four outcome measures for the first analysis. The between-subjects factors were student type (LD vs. NLD) and the experimental condition (experimental vs. control). The four outcome measures were VOC, CLP-notes, TLP-notes, and TW-notes. A second MANOVA was conducted with two between-subjects factors and three outcome measures of achievement. The between-subjects factors again were student type (LD vs. NLD) and the experimental condition (experimental vs. control). SPSS for Windows was used for the analyses and the criterion alpha level used for statistical
significance was .05. In the case of MANOVA, the effect size reported is partial eta squared ($\eta^2$) and is used as an estimate of variance in the dependent variables (Tabachnick & Fidell, 2001). According to Cohen (1988), $\eta^2$ coefficients of .138 or larger represent a large effect size; $\eta^2 = .059$ a medium effect size, and $\eta^2$ = .010 a small effect size.

### Results

#### Research Questions 1 to 4

Would students who used strategic note-taking record more cued lecture points, more vocabulary words, more total lecture points, and overall, more notes, in terms of words recorded, than students in the control group?

A MANOVA revealed that the Experimental Group $\times$ Student Type interaction was not significant. The overall main effect was found to be significant with student type, Wilks’s $\Lambda = .84, F(4, 97) = 4.48, p < .01, \eta^2 = .16$; and experimental group, Wilks’s $\Lambda = .79, F(4, 97) = 6.83, p < .001, \eta^2 = .21$; and on the four outcome measures (i.e., VOC, CLP-notes, TLP-notes, and TW-notes).

Follow-up analyses were conducted to address the first four research questions relating to how well students would record notes on the outcome measures. Specifically, through these analyses the investigator sought to answer whether students in the experimental group would record more TLP, CLP, VOC, and TW in notes compared to students in the control group. Because four measures were used, the Bonferroni correction was used with an $\alpha$ of .013. For all four of the outcome measures on notes, there was a significant difference between the experimental and control group on TLP, $F(1, 100) = 21.10, p < .001, \eta^2 = .17$; CLP, $F(1, 100) = 16.40, p < .001, \eta^2 = .14$; VOC, $F(1, 100) = 12.53, p < .01, \eta^2 = .11$, and TW, $F(1, 100) = 21.88, p < .001, \eta^2 = .18$. There were also significant differences between students with LD and NLD for TLP, $F(1, 100) = 11.79, p < .01, \eta^2 = .11$; CLP, $F(1, 100) = 16.33, p < .001, \eta^2 = .14$; and TW, $F(1, 100) = 9.21, p < .01, \eta^2 = .08$; however, VOC was not significant. With the exception of VOC, students (both with LD and NLD) in the experimental group outperformed students in the control group of their respective type (i.e., NLD and LD) on TLP, CLP, and TW in notes. Because of the anomaly found with VOC, follow-up $t$ tests were conducted to determine if there was a significant difference between students with LD (experimental students and control group students) or students with NLD (experimental students and control group students) in terms of performance on VOC.

To reduce the probability of Type I error, a higher alpha level ($\alpha = .01$) was used in the $t$ tests. Using the higher alpha level, the analysis found a significant difference between the experimental and control groups for students with NLD on VOC; however, the difference between experimental and control group for students with LD was not significant.

Table 2 illustrates the average scores for both groups on their note-taking performance as it relates to their use of the SN strategy. As shown from the table, both types of students (i.e., NLD and LD) in the experimental group exhibited significantly higher scores than the control students on measures of CLP, TLP, and TW in notes. Finally, on the VOC measure, students with NLD in the experimental group outperformed the control group.

#### Research Question 5

Would students who used strategic note-taking perform better on the achievement measures of immediate and long-term free recall measures and a comprehension test than students in the control group?

A second MANOVA revealed that the Experimental Group $\times$ Student Type interaction was not significant. Moreover, this MANOVA found an overall significant effect on student type, Wilks’s $\Lambda = .86, F(3, 98) = 5.28, p < .01, \eta^2 = .14$; and experimental group, Wilks’s $\Lambda = .82, F(3, 98) = 7.05, p < .001, \eta^2 = .18$, when using between-subjects factors of student type (LD vs. NLD) and the experimental condition (experimental vs. control) on the three achievement measures (i.e., TS, TLP-IFR, and TLP-LFR).

Follow-up analyses sought to address how well students in the experimental and control groups would perform on

### Table 2. Number of Lecture Points (Cued and Total), Vocabulary, and Total Words in Notes

<table>
<thead>
<tr>
<th>Measure</th>
<th>Experimental students ($n = 52$)</th>
<th>Control students ($n = 52$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Cued lecture points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>6.03*</td>
<td>(2.06)</td>
</tr>
<tr>
<td>LD</td>
<td>5.67</td>
<td>(2.09)</td>
</tr>
<tr>
<td>Combined groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total lecture points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>29.16*</td>
<td>(13.54)</td>
</tr>
<tr>
<td>LD</td>
<td>22.00*</td>
<td>(14.73)</td>
</tr>
<tr>
<td>Combined groups</td>
<td>27.23</td>
<td>(14.09)</td>
</tr>
<tr>
<td>Vocabulary</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>7.74*</td>
<td>(2.58)</td>
</tr>
<tr>
<td>LD</td>
<td>7.00</td>
<td>(3.01)</td>
</tr>
<tr>
<td>Combined groups</td>
<td>7.54</td>
<td>(2.69)</td>
</tr>
<tr>
<td>Total words</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>160.68*</td>
<td>(72.39)</td>
</tr>
<tr>
<td>LD</td>
<td>128.43*</td>
<td>(89.17)</td>
</tr>
<tr>
<td>Combined groups</td>
<td>152.00</td>
<td>(77.70)</td>
</tr>
</tbody>
</table>

*Significant at .013 level.

Note: NLD = students with no learning disabilities; LD = students with learning disabilities.
measures of achievement. Again, using the Bonferroni correction ($\alpha = .017$) for all three of the outcome measures on achievement, there was a significant difference between the experimental and control group on TS, $F(1, 100) = 14.74$, $p < .017$, $\eta^2 = .13$; and TLP-IFR, $F(1, 100) = 6.35$, $p < .017$, $\eta^2 = .06$; however, TLP-LFR was not significant. There were also significant differences between students with LD and NLD for TS, $F(1, 100) = 6.55$, $p < .017$, $\eta^2 = .06$; and TLP-IFR, $F(1, 100) = 9.35$, $p < .017$, $\eta^2 = .09$; however, TLP-LFR was not significant. Table 3 illustrates the average scores for both groups on the three achievement measures. As shown in the table, both types of students (i.e., NLD and LD) in experimental group exhibited significantly higher scores than the control students on TS and TLP.

The final measure was the Strategic Note-taking Student Questionnaire. Students’ ratings for the questionnaire fell within the upper range for all of the items (range for all items = 3.00–3.42 out of 4.0), with the following items receiving the highest ratings: strategic note-taking can help me improve my science grade ($X = 3.42$), strategic note-taking helps me to record better notes ($X = 3.40$), and I liked strategic note-taking better than my previous note-taking ($X = 3.35$).

**Discussion**

The dearth of researched-based note-taking techniques for students with disabilities limits the options that teachers have for helping students learn science content during lectures. Moreover, recent calls have been made for research that identifies best practices for students in secondary inclusive content-area classrooms (Mastropieri & Scruggs, 2001; Scruggs et al., 2010). The current study replicates and extends a prior study (Boyle & Weishaar, 2001) by using it with middle school students, using it with students with LD and NLD, and examining several different components of measures as they relate to achievement. As such, this study extends prior research by identifying a note-taking technique that is promising for both students with LD and with NLD who receive science instruction in inclusive settings.

**Relevance of the Study**

The findings from the present study point to several important aspects of strategic note-taking when used by students with LD and NLD. First, as mentioned earlier, it is essential for students to record CLP because of the importance that CLP serve at helping students structure (i.e., organizational cues) certain portions of their notes, the importance of such CLP from the teacher’s perspective (i.e., importance cues), and, perhaps most important, CLP have been shown to be moderately correlated to test performance. In the Boyle (2010) study, when student’s notes were examined in terms of end products such as total words, total lecture points, total NCLP, and total CLP, CLP were found to have the highest correlation with test performance (i.e., Pearson’s $r = .53$). Unfortunately, students with LD who are not trained to recognize and record CLP in lectures perform poorly at recording CLP in their notes (i.e., using conventional note-taking, middle school students with LD only recorded an average of 18% of CLP from lectures; Boyle, 2010). Furthermore, control group subjects with LD in this study recorded an average of only 20% of the total possible CLP (i.e., 2.57 CLP when compared to the total possible of 13 CLP), compared to students with LD who used SN strategy and recorded an average of 36% CLP from the lecture. Not only was this difference statistically significant for students with LD, but this 36% recorded CLP matched that for students with NLD who used conventional note-taking.

A similar, yet smaller, difference was exhibited by students with NLD who used strategic note-taking when compared to peers who used traditional note-taking. Students in the experimental group recorded an average of 46% of all CLP lecture points, compared to 36% CLP for students in the control group. While the difference between the two NLD groups is small, it may be that students with NLD already possess adequate note-taking skills and, therefore, have less room for improvement. Also, it appears that students reach maximum levels of recording CLP at about 50%. For example, in one study among college students with NLD, these students recorded 54% of CLP using conventional note-taking (Titsworth & Kiewra, 2004). The findings from the current study extend the note-taking

---

**Table 3. Achievement Measures of Experimental Groups and Type of Students**

<table>
<thead>
<tr>
<th>Measure</th>
<th>Experimental students ($n = 52$)</th>
<th>Control students ($n = 52$)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$M$</td>
<td>$SD$</td>
</tr>
<tr>
<td>Test score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>75.84*</td>
<td>(14.01)</td>
</tr>
<tr>
<td>LD</td>
<td>69.93*</td>
<td>(19.52)</td>
</tr>
<tr>
<td>Combined groups</td>
<td>74.25</td>
<td>(15.70)</td>
</tr>
<tr>
<td>Total lecture points of IFR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>6.68*</td>
<td>(2.83 )</td>
</tr>
<tr>
<td>LD</td>
<td>5.36*</td>
<td>(2.06 )</td>
</tr>
<tr>
<td>Combined groups</td>
<td>6.33</td>
<td>(2.70 )</td>
</tr>
<tr>
<td>Total lecture points of LFR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NLD</td>
<td>5.74</td>
<td>(2.32 )</td>
</tr>
<tr>
<td>LD</td>
<td>4.93</td>
<td>(3.05 )</td>
</tr>
<tr>
<td>Combined groups</td>
<td>5.52</td>
<td>(2.53 )</td>
</tr>
</tbody>
</table>

Note: NLD = students with no learning disabilities; LD = students with learning disabilities; IFR = immediate free recall; LFR = long-term free recall.

*Significant at .017 level.
research base, in terms of examining whether middle school students with NLD can increase the number of CLP recorded in notes when using a generative note-taking technique and whether students with LD can increase the number of CLP to meaningful levels (i.e., levels that matched peers with NLD) (Titsworth, 2004; Titsworth & Kiewra, 2004).

**Total lecture points recorded in notes.** Next, the findings also show two important aspects with respect to the total notes recorded. First, students with LD who used strategic note-taking recorded a higher percentage of TLP than students with NLD in the control group. Compared to the TLP from the lecture (i.e., 73 TLP), students with LD who used strategic note-taking recorded an average of 30% of the TLP, exceeding the control group who averaged 13%, as well as the control group of students with NLD who averaged 26%. Again, previous research has shown that middle school students with LD who used traditional note-taking only recorded an average of 13% of TLP (Boyle, 2010) and this study confirms those results. Second, students with NLD who used strategic note-taking recorded significantly more notes, approximately 40% of the TLP from the lecture, than students using traditional note-taking who averaged 26%, and these levels exceeded note-taking levels found in previous studies (i.e., 25%, Boyle, 2010; 27%, Risch & Kiewra, 1990) among students with NLD. Finally, students with LD and NLD outperformed their respective control groups in the number of words (i.e., TW) recorded in notes.

**Vocabulary recorded in notes.** In terms of vocabulary words recorded, students with NLD on average recorded 7.74 out of 10 vocabulary words, compared to the control group, which on average recorded only 5.89 key vocabulary words. Overall, more than half (i.e., 56%) of the students with NLD in the strategic note-taking group recorded either 9 or all 10 of the key vocabulary words, compared to a quarter (i.e., 24%) of the students with NLD in the control group. Although a significant difference was not found between students with LD in the experimental and control groups, it is interesting to note that the strategic note-taking group on average recorded 7 of the 10 key vocabulary words, approaching the level of recorded vocabulary found among students with NLD in the strategic note-taking group.

**Achievement measures.** Finally, the results of strategic note-taking on student achievement show that students in strategic note-taking groups outperformed students who recorded notes using traditional note-taking. In terms of comprehension, students in the strategic note-taking group performed better on the 15-point multiple-choice test, with experimental students with NLD performing best with an average score of 75.84% compared to control students with NLD who had an average score of 64.71%. Likewise, students with LD in the strategic note-taking group had an average score of 69.93% compared to students with LD in the control group who had an average score of 49.97%. Like other measures used in this study, students with LD who used strategic note-taking performed better than their peers with LD in the control group and slightly better than students with NLD in the control group. Other note-taking studies typically allow students to review their notes before taking a test to enhance long-term memory of lecture notes and to erase from working memory the recently presented lecture content (Lazarus, 1991; Titsworth, 2001a, 2001b; Titsworth, 2004; Titsworth & Kiewra, 2004); however, in the present study, in order to control for the effects of studying on test performance, students were not permitted to study their notes prior to administering the test or recall measures. Therefore, students’ scores represent achievement gains made without the benefit of studying for the test.

Significant differences were also found on the immediate recall measure for students in the experimental group, with the experimental group of students with NLD performing better on the IFR measure (6.88 and 5.74, respectively) than the control group (5.66 and 4.87, respectively). In terms of LFR measures, significant differences were not found between the experimental and control groups (i.e., NLD and LD), despite these groups exhibiting higher average scores (NLD SN = 5.74 vs. NLD control = 4.87; LD SN = 4.93 vs. LD control = 3.21). This was an interesting finding because although SN appears to aid immediate recall (IFR) and comprehension (TS) for students with NLD and LD, it did not appear to aid their long-term free recall. The findings from the current study extend the research base (Titsworth, 2004; Titsworth & Kiewra, 2004), particularly in terms of examining TLP recorded by middle school students with LD and NLD in their notes and the resulting increases in achievement when compared to conventional note-takers on comprehension and immediate recall measures (Boyle, 2010; Risch & Kiewra, 1990).

**Limitations of the Research and Future Directions**

The study was limited in several ways. First, the current study used a no-treatment control group. Although the use of a no-treatment control group is a common procedure that has been used in past note-taking research (Hamilton, Seibert, Gardner, & Talbert-Johnson, 2000; Patterson, 2005; Risch & Kiewra, 1990), its use does present a possible weakness because some note-taking training of control subjects may have lessened the difference in the effect of the independent variable. Another limitation has to do with the generalizability of the intervention. Because only one lecture was used, it is possible that the technique may not generalize, without student training, to other lectures. Furthermore, the use of a videotaped lecture, while controlling for extraneous variables, also restricts the authenticity of the science lecture and reduces generalizability.

Future studies should examine several aspects of strategic note-taking and other note-taking techniques. As mentioned, future research should examine the effects of
strategic note-taking over several lectures to see if students can successfully use it over time and with different types of science content. These lectures should incorporate sessions using middle school science content and should be taught by middle school science teachers. Finally, future studies should examine the effects of different review/study periods of recorded notes on learning. These study periods could vary from short periods of 3 to 5 min to longer periods of time (i.e., upwards to 15 or 20 min of studying). Related to this, future studies should also examine the effects using strategic note-taking over several days (i.e., with a similar lecture topic) before taking a test. Doing so would accurately authenticate what actually happens in the classroom as students record notes over several days before taking a unit or chapter test.

Educational Implications and Conclusion

When teaching strategic note-taking to students, teachers should be cognizant of the critical aspects of note-taking that include reviewing prior knowledge and linking it to the lecture topic, using a simplified version to clump like ideas together under a common heading, recording important vocabulary, recognizing teacher cues and recording the associated lecture points, reviewing notes after the lecture, and paraphrasing or recording important portions of lecture points. Once students have mastered these components of strategic note-taking, they should be taught to generalize the technique. Because generalization is an issue for students with LD (Deshler et al., 2006), teachers should train students to use SN with different types of content and in different settings. For some students, this may involve recognizing lectures cues (e.g., verbal and nonverbal) that each teacher uses in different classes and recognizing which aspects of the lecture are important for learning different science concepts. In particular, students should be taught to hone in and record import lecture content for upcoming tests, quizzes, or projects. Throughout the teaching and transfer of note-taking techniques, teachers should monitor students for the quality and quantity of their notes. By sitting down and reviewing notes with students, teachers can point out inaccuracies and missing lecture points. In doing so, teachers can provide students with specific, individualized feedback to improve their note-taking. Finally, along with note-taking skills, teachers should show students how to study notes for tests, how to transfer information from notes to index cards to make studying large quantities of information more manageable, and how to develop simulated test questions from important lecture points from students’ notes. Through improved note-taking, students not only gain access to the general education science curriculum but can learn how to master important science concepts and better understand how science impacts our lives on a daily basis.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

References


**About the Author**

Joseph R. Boyle, PhD, is currently an associate professor of special education at the Graduate School of Education at Rutgers University. His current interests include academic interventions in reading, writing, and note-taking.