Note This: How to Improve Student Note Taking

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Abstract

Students are incomplete note takers who routinely record just one third of a lesson's important information in their notes. This is unfortunate, because the number of lesson points recorded in notes is positively correlated with student achievement. Moreover, both the activity of recording notes and the subsequent review of notes are advantageous. The authors offer instructors a menu of research-based advice for bolstering student note taking: provide complete notes, provide partial notes, provide note-taking cues, re-present the lesson, provide pauses and revision opportunities, control laptop usage, control "cyber slacking," use PowerPoint slides effectively, and teach note-taking skills. They also suggest ways to help students transform their notes during the note-review process and SOAR (select, organize, associate, and regulate) to success.

Keywords: Note taking, SOAR, strategy instruction

Kenneth Kiewra began his note-taking investigations while a graduate student at Florida State University in 1979. This research interest was prompted by his statistics professor, Harold Fletcher, who outlawed student note taking during class. Fletcher told his students that taking notes diverted their attention from the lecture; it was better to listen and think about the material than to mindlessly record what was being said. Yet Fletcher realized that students needed notes to review later, so he prepared written lesson notes and offered them to students following each class.

Most students embraced the idea of kicking back during lectures and getting comprehensive notes afterward, but not Kiewra. He was a voracious note taker who had been named Note Taker of the Year Runner-Up twice in college. So, in Professor Fletcher's class, Kiewra became a closet note taker. He retreated to the back of the room and sat behind a former Seminole lineman, concealed by his bulk. There he huddled over a small notepad and wrote feverishly whenever Fletcher looked away. One day, as Kiewra scribbled, he sensed a presence creeping up on him from behind. He looked up to see Fletcher peering down at the notepad. "Mr. Kiewra, are you taking notes in my class?" Dr. Fletcher asked. Caught pen-handed, Kiewra could do nothing but lie: "Ah, no, I'm writing a letter to a friend back home." Staring down at the now exposed pad, Fletcher retorted, "Well, how nice of you to tell your friend about omnibus testing."

Prompted by this experience, Kiewra conducted six note-taking studies under Fletcher's supervision while in graduate school and has continued investigating note taking ever since, seeking optimal ways for students to record notes and for instructors to aid student note taking. Recently, Kiewra's note-taking expertise had its day in court when he was summoned as an expert witness by a major energy company under fire from the US Securities and Exchange Commission for misleading investors. The evidence: investors' meeting notes with energy-company

executives. Kiewra examined the notes and described note-taking research that might invalidate them (2016). Case closed.

Now that you know a bit about the first author's note-taking background, you have some context for the rest of our paper on this practice. First we explain why note taking is potentially effective and important for student achievement. Next we describe problems associated with students' notes that reduce their effectiveness. Last, we address several ways that instructors can improve student note taking and thus raise achievement.

Why Note Taking Is Effective

Most students take notes (Bonner & Holliday, 2006; Castello & Monereo, 2005), which is good because note taking serves two functions: process and product. The process of note taking (as Kiewra tried to do in Professor Fletcher's class) and the product, the notes themselves (as Fletcher arranged), both boost achievement. The process of taking notes is effective (Bligh, 2000; Einstein, Morris, & Smith, 1985; Kiewra, Mayer, Christensen, Kim, & Risch, 1991; Suritsky & Hughes, 1991) because the activity focuses students' attention on instruction (e.g., Katayama & Crooks, 2003; Kobayashi, 2006; Piolat, Olive, & Kellogg, 2005) and leads to better assimilation of lesson ideas with prior knowledge than does simply listening (Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). However, some studies do not show a process advantage for note taking, meaning that simply listening during a lesson is as effective as recording notes during it (Fisher & Harris, 1973; Glover, Zimmer, Ronning, & Petersen, 1980; Kiewra et al., 1991; Riley & Dyer, 1979).

Note taking's product function is effective (e.g., Armbruster, 2000; Fisher & Harris; Kiewra, 1985, 1989; Knight & McKelvie, 1986; Luo, Kiewra, & Samuelson, 2016) because it allows more time for meaningfully processing recorded ideas when notes are reviewed following the lesson (e.g., Crooks, White, & Barnard, 2007; Kiewra, 1985; Kiewra et al., 1991). Some studies try to determine which of note taking's two functions is stronger. This line of investigation generally confirms that the product function is stronger than the process function (Kiewra et al., 1991; Kobayashi, 2005; Rickards & Friedman, 1978). We contend, however, that both functions are important and improvable and that comparing their relative merits is akin to asking, "Which is more important, writing a letter or mailing it?"

What Is Wrong with Students' Notes?

For notes to be optimally effective, they must be complete. The more complete that students' notes are, the higher those students' achievement (e.g., Kiewra, 1985; Nye, Crooks, Powley, & Tripp, 1984; Peverly, Garner, & Vekaria, 2014). Unfortunately, most students' notes are woefully incomplete. Students, on average, record just one third of important lesson ideas (Austin, Lee, & Carr, 2004; Kiewra, 2016; Titsworth, 2004). To understand how problematic this is, imagine asking someone for their phone number. They report their full 10-digit number, but you record just 3 of those digits. Good luck placing a call later! Similarly, examine Figure 1, which shows what one-third note completeness looks like. Imagine studying these spotty notes weeks later in preparation for an exam.

Figure 1. What recording one third of lesson information in notes looks like (shown in black).

Why are students such incomplete note takers? One reason is probably what we might call technical difficulties (Bassili & Joordens, 2008; Bui & Myerson, 2014; Peverly et al., 2013). Most lectures are presented at a rate of approximately 120 to 180 words per minute (Wong, 2014). This rate is too fast for most note-taking students, who on average can keyboard at just 33 words per minute (Karat, Halverson, Horn, & Karat, 1999) or write longhand at just 22 words per minute (Brown, 1999). In other cases, students are known to record fewer notes

when (a) visual aids are shown or questions are asked by other students (Maddox & Hoole, 1975); (b) the lesson topic is familiar (Trevors, Duffy, & Azevedo, 2014; Van Meter, Yokoi, & Pressley, 1994); (c) they are feeling fatigued, especially in the latter portions of lectures (Locke, 1977); or (d) they are pulled off-task by digital distractions such as cell phones and laptops (Kuznekoff & Titsworth, 2013).

Students' notes are not only generally incomplete but are also missing vital details, examples, and qualifiers or are just plain inaccurate. Students actually do a good job of recording a lesson's superordinate main ideas but fail to record its subordinate details (Kiewra & Benton, 1988). In one note-taking study, Kiewra, Benton, and Lewis (1987) counted the percentage of ideas that students noted, at various levels of detail. To get a sense of how this was done, consider the following sentences from what might be a lesson on note taking, and the corresponding levels of ideas therein:

> Note taking increases achievement (level 1) through its process and product functions (level 2). The process function involves the activity of note taking (level 3) and is measured by comparing the achievement of note takers and listeners (level 4).

Students' notes became progressively less complete as lesson ideas grew in subordination levels and detail. Students recorded 91% of the most superordinate level 1 ideas, 60% of level 2 ideas, 35% of level 3 ideas, and only 11% of the most subordinate, level 4 ideas.

Students often omit examples from notes. In the study conducted by Austin et al. (2004), students recorded notes pertaining to only 13% of lesson examples, even though examples are often crucial for understanding lesson ideas. Consider how difficult it is to understand the following rule regarding comma usage without the accompanying example, which demonstrates what is meant by "coordinate conjunctions" and "main clauses."

> Use a comma if there is a coordinate conjunction joining two main clauses. *Paradise was an exclusive country club* (main clause)*, but* (coordinate conjunction) *the gates of hell were open* (main clause)*.*

Qualifiers are often absent from students' notes, too (Maddox & Hoole, 1975). Qualifiers are usually adjectives that are added to nouns to qualify a noun's meaning. Suppose a lecturer says, "Monsoons are likely in western coastal areas," but a student writes down, "Monsoons occur in coastal areas." The student has missed the important qualifier "western" and will later review their recorded statement that erroneously suggests that monsoons occur in all coastal areas. In Kiewra's court case (2016), mentioned earlier, an energy-company executive stated, "If recent trends hold true, the site can produce 100 million barrels of oil," but an investor missed the qualifier "if recent trends hold true" and tersely wrote, "the site can produce 100 million barrels of oil."

Students also sometimes record information inaccurately. In one study, Crawford (1925) found that 53% of noted information was fully correct, 45% was vague, and 2% was inaccurate. Another study (Maddox & Hoole, 1975) indicated that 61% of note takers introduced one or more inaccuracies into their notes and that most inaccuracies involved numerals. A third study (Johnstone & Su, 1994) also reported that notes contain inaccuracies and that most occur when copying diagrams and numerical information.

What Instructors Can Do to Aid Note Taking

There are several research-based techniques that instructors can use to improve student note taking and the resulting notes: provide complete notes, provide partial notes, provide note-taking cues, re-present the lesson, provide pauses and revision opportunities, control laptop usage, control "cyber slacking," use PowerPoint slides effectively, teach note-taking skills, and help students transform notes and SOAR (select, organize, associate, and regulate) to success. We discuss each technique, and the research supporting it, in turn.

Provide Complete Notes

It appears that Professor Fletcher knew what he was doing when he provided students with a complete set of notes to review. Research confirms that students who review provided notes achieve more than students who record and review their own notes. In a study by Kiewra and Benton (1987), college students watched a 20-minute video lesson on learning hierarchies, with one group of students taking notes while another group abstained. Note takers later reviewed their notes; non–note takers reviewed a set of provided notes that were complete. Following the 25-minute review period, all students were tested on the lesson. Those who reviewed the provided notes achieved 17% higher scores than the students who reviewed their own notes—not surprising, given that the provided notes contained all 115 lesson ideas, whereas

students' own notes contained, on average, just 38% of lesson ideas.

One study (Kiewra, 1985) went so far as to show that reviewing a complete set of provided notes can even compensate for missing a lesson. Students attended a 20-minute lesson on the purpose and construction of learning hierarchies and either took notes or simply listened. Another group of students did not attend the lesson at all. Later, students reviewed either no notes, their own notes, a complete set of provided notes, or both their own notes and provided notes, resulting in the seven groups shown on the left side of Table 1; the right side shows the test results. Notice that the top-performing groups all studied the complete notes, the bottom-performing groups all had no notes to study, and the middle-performing group took their own notes and studied only those. Those self-recorded notes, by the way, contained, on average, just 35% of the important ideas included in the lesson and in the provided notes. These findings confirm that note taking's primary value lies in its product function and that it is important to have a complete set of notes to review, regardless of what occurs at acquisition—listening only, taking notes while listening, or being absent. Moreover, the tried-and-true method of recording and reviewing one's own notes is relatively ineffective.

Table 1
Note-Taking Groups and Their Test Results Reveal the Achievement Value of Provided Notes

Groups	Test Results
Take notes/Review own + provided	71%
Not attend/Review provided	69%
Listen/Review provided	63%
Take notes/Review own	51%
Take notes/Review no notes	44%
Listen/Review no notes	43%
Not attend/Review no notes	33%

In a study involving text learning (Colliot & Jamet, 2018a), college students read a 1,500-word text on memory at their own pace. Some of the students were also provided with a complete set of notes in hierarchical form, showing all 21 superordinate and subordinate lesson ideas. Others were asked to create hierarchical notes on their own, which they did with 100% accuracy and completion. Unfortunately, recording one's own notes took a toll on achievement. Those provided with complete notes outscored the note takers by 16%, 12%, and 17% on tests measuring main ideas, hierarchical relationships, and problem solving, respectively. These results were replicated when the hierarchical form was replaced with an outline form (Colliot & Jamet, 2018a).

Perhaps instructors are not inclined to do students' work for them or fear encouraging absenteeism by providing a complete and ready-made set of notes to review. Or perhaps instructors recognize note taking's process value and do not want to forgo that. Both of these potential problems can be addressed by providing students with partial notes.

Provide Partial Notes

A simpler note-providing alternative, which shares note-taking responsibilities between instructors and students and maintains note taking's process benefit, is partial notes. Partial notes provide only main ideas and cue students to record additional notes in blank spaces. In one study investigating partial notes (Kiewra, Benton, Kim, Risch, & Christensen, 1995), students attended a video lesson on the topic of creativity and recorded notes either from scratch or on distributed partial notes, such as those in Figure 2. Those taking notes on their own recorded 38% of important lesson ideas, whereas those using partial notes recorded 56% of important lesson information. Group achievement differences mirrored those for note taking.

Figure 2. Partial notes for a lesson on creativity.

	Creativity		
	Adaptive Creativity	Innovative Creativity	Emergent Creativity
Outcome:			
Motivation:			
Time Demands:			
Example:			

Some studies have investigated the benefits of partial notes when students learn from text presented via computer. One key finding is that when partial notes are provided and students are given the choice to either type or copy and paste notes into text boxes, approximately 80% of students choose to copy and paste notes (Igo, Bruning, McCrudden, & Kauffman, 2003). Although copying and pasting often leads to more complete notes than typing—40% versus 20% (Bauer & Koedinger, 2007)—the former leads to lower achievement. Such was the case when students who typed notes onto partial outlines while reading chapter-length texts achieved more on both immediate and delayed application tests than those who copied and pasted notes, with each test administered following note review (Katayama, Shambaugh, & Doctor, 2005).

The problem with copying and pasting is that students tend to copy and paste too much information into their notes. They sometimes copy and paste entire paragraphs or sentences and do so without much cognitive engagement or thought (Igo & Kiewra, 2007; Igo, Kiewra, & Bruning, 2008). According to Stacy and Cain (2015), "An application that allows students to copy and paste prewritten notes without including their own definitions and elaborations is much less effective than one that encourages personally written language. While verbatim notes may be more accurate, the benefit of 'process' is absent, and therefore, lessens the effect of the learning experience" (p. 3). Perhaps a middle ground is restricting the amount of notes that students copy and paste. When researchers (Igo, Bruning, & McCrudden, 2005) restricted copy-and-paste note taking in partial notes to a maximum of only seven words per note-taking cell, those recording restricted notes achieved more than those whose copy-and-paste note taking was unrestricted: 12% higher at recalling text ideas, 20% higher at identifying new examples, and 28% higher at comparing text ideas. Restricting the amount of notes forced copy-and-paste note takers to read information carefully and be more selective about what they recorded.

Regarding whether it is better for instructors to provide complete or partial notes, findings are mixed. In a study favoring partial notes (Katayama & Robinson, 2000), college students studied a chapter-length text on sleep disorders and received either complete notes on this topic or a series of partial organizers to complete in either outline or matrix form. Students with partial notes achieved more on an application test than those with complete notes by an 18% margin.

In a study favoring complete notes (Stull & Mayer, 2007, Experiment 3), college students studied a text about reproductive barriers between species and received either complete notes or partial organizers that needed to be completed while reading. Those who received complete notes achieved 50% more on a problem-solving test than those who received partial notes.

Finally, provided complete notes and partial notes proved comparable in another learning-from-text study (Colliot & Jamet, 2018c). College students read a 1,500-word text on memory, presented on the computer. One group received a completed organizer showing the lesson's 21 superordinate and subordinate ideas in hierarchical form. Another group recorded notes on a hierarchy framework (partial notes) that contained space to record superordinate and subordinate ideas. Following the lesson, the two groups performed comparably on tests measuring main ideas, hierarchical relationships, and problem solving. Both groups, though, outperformed a third group of students, who had to create their own hierarchy without assistance, by 20% to 30%, indicating once again the value of provided notes (whether complete or partial) over students' self-generated notes.

In conclusion, partial notes seem to be a good compromise for aiding note taking and learning. First, rather than instructors doing all the note-taking work, that task is shared by instructor and students. Second, partial notes engage students in the note-taking process. They make students attentive and active learners during lecture and text lessons while relieving students of some of the burden of trying to record a complete set of notes on their own. In addition, providing partial notes raises note taking beyond what students typically record on their own, thereby resulting in a relatively complete and effective set of notes for review.

Provide Note-Taking Cues

Instructors can easily deploy two types of lesson cues to boost note taking: importance cues and organizational cues. Cues signaling importance can be written, presented orally, or delivered nonverbally. In one study, students recorded 86% of information written on the blackboard (Locke, 1977). Providing written questions is another way to signal what is most important in a lesson. Rickards and McCormick (1988) had college students listen to an 800-word lecture, divided into 16 sections, about the fictitious country of Mala. Some students received a pre-question before each segment to focus their attention

on that material. Pre-questions raised both note taking and achievement: Those who received pre-questions recorded 20% of the lesson's critical information, versus the only 2% recorded by those who did not receive them. Regarding achievement, those who received pre-questions recalled approximately 25% more material than those who did not.

Oral lesson cues might include an instructor saying, "This point is noteworthy/imperative/absolutely critical/likely to be on the test." Sometimes it is not just what instructors say but how they say it that signals importance. Variance in voice pitch, cadence, volume, or rate can let students know that information is noteworthy. So too can repeating information.

Nonverbal cues also signal importance. One college instructor whom we know emphasizes important points nonverbally by cradling his chin in his hand, thrusting out his bottom lip, arching his eyebrows, and nodding his head vehemently. His students know to write feverishly when this cue medley erupts. In a reported study (Moore, 1968), a lecturer held up cards that signaled whether note taking was warranted—green for yes and red for no—in one class but not in another, for 12 lectures over a six-week period. The class that received cues outperformed the class that did not on an achievement test covering the lecture material. Other nonverbal cues might include pointing, clapping, finger snapping, hand waving, a piercing glance, or a rap on the table. Saying nothing can also serve as a cue. When instructors pause after delivering a lesson point, most students probably know to fill the silence with note taking.

Organizational cues alert students to the lesson's structure, and they raise both note taking and achievement. In a study investigating organizational lesson cues (Titsworth & Kiewra, 2004), students listened to one of two forms of a lesson: cued or uncued. Both forms were well organized and identical, with one exception: The cued lesson signaled the lesson's organization by emphasizing the four lesson topics (the names of four communication theories) and the five lesson categories common to each topic (e.g., definition, example, application). For example, one lesson cue inserted in the lesson was "Next, we examine the *application* of *general systems theory*." Another was "Here is the *definition* of *mass media theory*." Each lesson cue set the stage for introducing an important lesson detail. There were 20 organizational cues spaced throughout the lesson. After the lesson, a brief period for note review was followed by two tests, one assessing lesson organization and one assessing lesson details. Notes were also analyzed for organizational points and details. Organizational cues positively impacted note taking and achievement. The cued group recorded approximately 40% more organizational points and 45% more details in notes than the uncued group. Higher rates of note taking led to higher achievement. The cued group achieved nearly seven times more on organizational points and nearly twice as much on details compared to the uncued group.

Re-present the Lesson

It might seem far-fetched for instructors to re-present a lesson to students, but instructors working in the digital world can easily do so when they make a recorded lesson available to students online so that it can be viewed more than once. But is there an advantage to multiple lesson viewings? Kiewra et al. (1991) discovered that there is. Students in their study watched a brief video lesson either one, two, or three times. Students in a fourth, free-viewing, group watched individually and controlled how the video was played: They could pause, rewind, fast forward, or replay any portion. In terms of note taking, all groups were equally effective, recording approximately 80% of the lesson's main ideas whether they viewed it three times or only once.

However, the groups varied in their recording of lesson details. Students who viewed the lesson two times recorded more details than those who viewed it only once (53% vs. 38%); the same was true of those who viewed it three times (60%) or on their own (65%). Achievement results mirrored note-taking results, because those who recorded more notes tended to achieve more. It is interesting to note how the free-viewing students viewed the lesson. All of them watched the lesson only once, never replaying it in its entirety. Instead, they often paused the lesson to jot notes, and they replayed brief sections that they thought required additional viewing. Their total viewing time approximated that of the three-viewings group.

Regarding whether students in authentic learning settings actually view posted lessons multiple times or slow down the viewing process as the free-viewing students did in the Kiewra et al. study (1991) is, to our knowledge, unknown. To determine students' viewing behaviors, instructors can ask them how they view posted lessons or perhaps track their viewing behaviors through a course's learning-management system. In the meantime, we encourage instructors to post lessons online whenever possible, prompt

students to replay or slow down posted presentations when they view them and tell students the note-taking and achievement benefits of doing so.

Provide Pauses and Revision Opportunities

Many lessons, especially recorded lessons, are presented too rapidly for students to keep pace and record adequate notes. Instructors should heed the simple advice to slow down. There is another way, though, to help students record more notes: provide lesson pauses and ask students to revise (i.e., add to and embellish) their existing notes. Luo et al. (2016) assessed the value of note revision in Experiment 1 of a two-experiment study. They played a 14-minute audiotaped lesson delivered at a rate of 136 words per minute for students, who were directed to record notes throughout the lesson. Following the lesson, students were either instructed to revise their notes or to merely recopy them, as students often do. Naturally, only those who revised added more lesson ideas to their notes. Revisers mildly outperformed note copiers on a fact test (3%) and a relationship test (13%).

In Experiment 2, the researchers assessed how best to carry out revisions. A new group of students heard the same lesson as those in Experiment 1, but this time students revised either for 15 minutes at the lesson's end or during three 5-minute pauses spaced throughout the lesson. In addition, students revised either alone or with a partner. Overall, revising during pauses with a partner produced more complete notes and higher fact and relationship scores than revising at the end of the lesson by oneself.

The researchers (Luo et al., 2016) contend that revision works because students can use their existing notes to retrieve other lesson ideas that they had not previously recorded. Having recorded the main idea that short-term memory is limited might help a reviser later retrieve the detail that short-term memory holds approximately seven bits of information and the example of a phone number conforming to short-term memory's limitation. The researchers contend that pauses work because students can retrieve their potential revisions from memory with less delay than if revision is saved until the end of the lesson. Lesson pauses probably also offset fatigue. And, the researchers contend, revising with partners is effective because partners can share notes and collaborate on revisions. Two heads are better than one.

Control Laptop Usage

Students' use of laptop computers to record notes is on the rise (Fried, 2008; Lauricella & Kay, 2010): Approximately one third of college students take class notes using laptops (Aguilar-Roca, Williams, & O'Dowd, 2012). Although most students can type more quickly than they can write (Brown, 1999; Karat et al., 1999), is laptop note taking a superior alternative to recording notes in longhand? As described in the next section, students are often distracted by their laptops and other digital devices during class, because they check text messages and surf Web sites unrelated to class topics.

Those problems aside, recent research (Luo, Kiewra, Flanigan, & Peteranetz, in press; Mueller & Oppenheimer, 2014) casts doubts on the viability of laptop note taking. The study by Luo and colleagues (2018) investigated the relative benefits of laptop note taking versus longhand, when notes are recorded and not reviewed (the process function of note taking) and when notes are both recorded and reviewed (the product function of note taking). Students watched a 23-minute, narrated PowerPoint lesson about educational measurement containing 23 slides with text and images. Achievement tests assessed text-based and image-based learning. To assess note taking's process effect, half the laptop and longhand note takers took achievement tests right after the lesson, without the opportunity to review. To assess note taking's product effect, remaining laptop and longhand note takers reviewed notes for 15 minutes before taking the achievement tests. Regarding note taking's process function, laptop and longhand note takers performed comparably on the image-based test, but the laptop group outscored the longhand group on the text-based test. Regarding note taking's product function, the longhand group outscored the laptop group on both the image-based and text-based tests.

Notes were analyzed as well and explained achievement differences (Luo et al., in press). Laptop and longhand note takers recorded equal amounts of lesson ideas—about one third of lesson points—but laptop notes were wordier than longhand notes and contained more verbatim strings. This is a measure of the degree to which students record lesson ideas verbatim rather than paraphrase them. Verbatim note taking is considered more superficial and less meaningful than paraphrased note taking, and some even call it mindless (Mueller & Oppenheimer, 2014). Longhand note takers, meanwhile, recorded images such as graphs and tables, but laptop note takers

recorded none of these things, perhaps because of the difficulty of capturing such images on a laptop.

The researchers (Luo et al., in press) concluded that longhand note takers recorded higher quality notes than laptop note takers: Notes were more efficient and contained more paraphrasing and more images. Recording notes of this quality had both a cost and a benefit. The cost was the additional cognitive strain during the lesson that somewhat hindered text-based learning if notes were not reviewed (the process function of note taking). The benefit was a superior set of notes for review (the product function of note taking) that, in turn, led to higher text-based and image-based achievement than did the review of laptop notes. And because the primary purpose of note taking is to create a complete and effective set of notes for review, the benefit was worth the price. Instructors, by the way, might believe that they can simply warn laptop note takers not to record verbatim notes because of their ineffectiveness. Researchers actually posed such warnings, but laptop note takers recorded verbatim notes nonetheless (Mueller & Oppenheimer, 2014). Instructors should make students aware of the potential disadvantages of laptop note taking as well as the following attention detriments.

Control "Cyber Slacking"

Cyber slacking is the unwarranted use of mobile technology in the classroom for purposes other than learning. Laptops and other mobile devices are ubiquitous in college classrooms and prove detrimental because they pull students off-task (Flanigan, 2018), limit note taking (Kuznekoff & Titsworth, 2013), and reduce achievement (McCoy, 2013, 2016; Dietz & Henrich, 2014). When Fried (2008) asked students how they used their laptops during class, 81% reported checking email, 43% reported surfing the Web, 25% reported playing games, and 35% reported other activities unrelated to learning. More recent studies confirm that (a) 70% of students send text messages via their phones during class (Emanuel, 2013; Kornhauser, Paul, & Siedlecki, 2016); (b) students send or receive approximately 20 text messages per class period (Dietz & Henrich; Pettijohn, Frazier, Rieser, Vaughn, & Hupp-Wildsde, 2015); (c) students spend more than half a typical class period using laptops for nonclass purposes (Ragan, Jennings, Massey, & Doolittle, 2014); and (d) students do all this even though they are aware that cyber slacking negatively impacts learning (Froese et al., 2012; McCoy, 2016).

One study cleverly examined the effect of students' mobile phone usage on note taking and achievement (Kuznekoff & Titsworth, 2013). College students assigned to one of three groups watched a 12-minute video lecture about communication theories with either no phone distractions (control group); low distraction, where students received a text message every 60 seconds; or high distraction, where students received a text message every 30 seconds. Students in the two distraction groups had to respond to the texts when they occurred, and all students recorded notes during the lecture and were tested following the lecture. Results showed that text distractions lowered note-taking quantity. Those in the control group recorded 33% of lesson ideas, compared to 27% for the low-distraction group and 20% for the high-distraction group. Text distractions also lowered achievement. The control group outscored the low-distraction group by 7% and the high-distraction group by 13% on a multiple-choice test and recalled approximately 50% and 100% more lesson ideas than those groups, respectively.

It is evident that students cyber slack in class and that doing so diminishes attention, note taking, and achievement. Some instructors, after observing students using digital technology to send emails and surf the Internet during class, have simply outlawed digital devices in class and insisted on longhand note taking (Fink, 2010). Flanigan and Kiewra (2018), meanwhile, offer instructors a menu of classroom strategies to minimize student cyber slacking, such as incorporating active learning experiences in the classroom, adopting and enforcing technology policies, making students aware of cyber-slacking temptations and consequences, incentivizing students to relinquish mobile phones in the classroom, and incorporating mobile technology in the classroom as a teaching tool.

Use PowerPoint Slides Effectively

Lessons taught using PowerPoint slides can aid student attention, note taking, and achievement. Frey and Birnbaum (2002) examined student perceptions of PowerPoint presentations and found that 69% of students believed that such presentations held their attention and 80% believed that printed PowerPoint handouts helped them take notes. Positive note-taking findings were confirmed in another study (Susskind, 2005), where half the lectures were taught in a traditional format and half were accompanied by PowerPoint slides. Students who experienced both formats reported that note taking was easier, more extensive, and more organized for PowerPoint lectures than for traditional lectures.

Instructors can raise student achievement by posting PowerPoint slides in advance of class. Chen and Lin (2008) tracked students' behavior of downloading PowerPoint slides before classes over one semester and their performances on three examinations during that semester. Downloading PowerPoint slides before classes had a large and positive effect on exam performance—even more than students' class attendance. Speaking of class attendance, be warned that providing PowerPoint slides might decrease students' class attendance. Among surveyed students, 75% agreed or strongly agreed that they were less motivated to attend class when PowerPoint slides were available (Gurrie & Fair, 2010).

When instructors provide students with PowerPoint slides, they should provide space for note taking. Students report that they learn better when they can simultaneously view the PowerPoint lesson and take notes (Gurrie & Fair, 2010). When providing note-taking space, instructors should follow two guidelines. First, the space should be ample; the more space that is provided, the more notes students will record (Boye, 2012). Second, instructors should place the note-taking space in close proximity to the related information. According to Mayer's spatial-contiguity principle (2007), people learn more from a multimedia lesson when corresponding printed words and graphics are presented near, rather than far from, each other on the page or screen. Spatial contiguity helps students build associations between notes and the corresponding information on slides.

Teach Note-Taking Skills

According to Kiewra (2009), a Grade-A teacher presents information so effectively that students cannot help but learn. To aid student note taking, Teacher A might slow the lecture, provide pauses to facilitate revision, insert lesson cues, provide partial notes, and outlaw unnecessary mobile technology. Although such teaching is certainly effective, it does not necessarily teach students *how* to learn on their own when they attend other classes. For that, Teacher A+ is needed (Kiewra, 2009). Teacher A+ does all the effective, nearly-guaranteed-student-learning things that Teacher A does, but also something more. Teacher A+ teaches students how to learn by embedding strategy instruction into content instruction. That is, as Teacher A+ teaches math or science or history or art, he or she also teaches lifelong strategies, such as those for note taking. Kiewra believes that all instructors have the opportunity if not the obligation to embed strategy training in content instruction and teach students how to learn. Let us see how Teacher A+ might embed strategy training related to note taking.

> *Class, I noticed that many of you recorded incomplete notes when I spoke last week about creativity. Here is a set of complete notes that I created for that lesson to model good note taking. I numbered each lesson point so that you can compare my notes with yours to see how many lesson points you omitted from your notes.*
>
> *I'm not surprised that most of you recorded about one third of the information compared to the notes that I provided. Research shows that most students record only one third of important lesson ideas. That's too bad, because research also shows that the more notes that students record, the higher their test performance.*
>
> *Let me teach you a strategy that I call note revision, which will make your notes more complete. Soon after a lesson, reread your notes and try to recall and record lesson information missing from them. For example, you noted that "adaptive creativity is the ability to use past knowledge to solve everyday problems"; that note might remind you of related information not contained in your notes, such as that adaptive creativity takes 3 to 5 years to master, or the adaptive creativity example of a homemaker preparing dinner for uninvited guests. Record such information in your revised notes to make them as complete as possible. Here's another tip: When you revise notes, try to do so with a partner, because that way you can share recorded ideas and make revisions together. Two heads are better than one.*

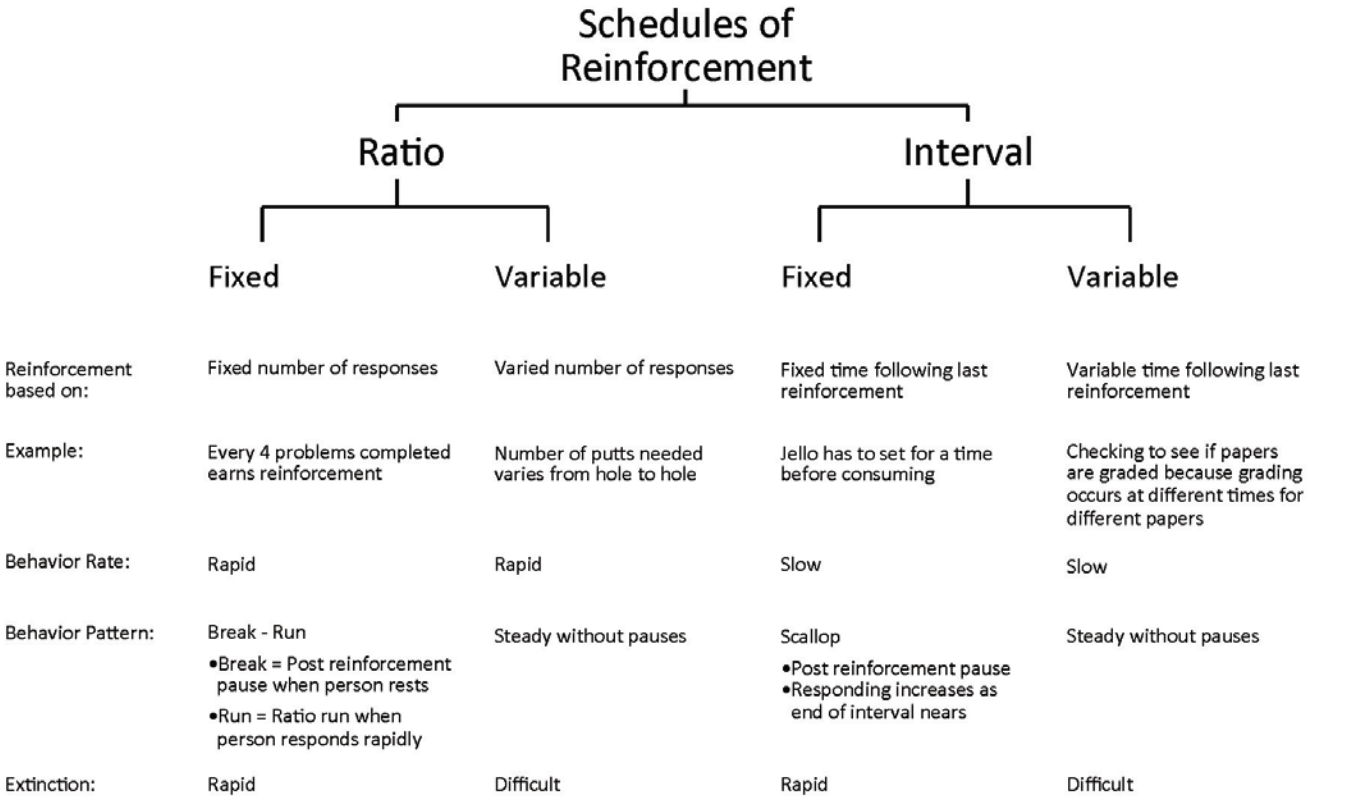
Help Students Transform Notes and SOAR to Success

Recording a complete set of notes is not the ultimate goal. As mentioned earlier, the primary value of note taking lies in reviewing recorded notes. Unfortunately, students often review their notes in shallow and ineffective ways—studying one idea at a time in a piecemeal fashion and employing redundant strategies such as recopying and rehearsing notes (Gubbels, 1999; Jairam & Kiewra, 2010; Van Meter et al., 1994). It has long been known that these shallow review activities do little to boost achievement (Jacoby, 1973).

Just as instructors can facilitate the note-taking process, they can facilitate note review by helping students transform their notes in ways that help them SOAR to success (see Kiewra, 2009). SOAR is an acronym for the four critical aspects of learning: select, organize, associate, and regulate. When students record complete notes, they fulfill the *select* aspect of SOAR: They select and record all the important lesson information for further study.

Having a complete set of notes is advantageous, but the form of most notes is not. Most notes are in linear form—a series of sentences and lists that obscure associations among lesson ideas. Whenever possible, instructors should help students fulfill the *organize* aspect of SOAR by providing them with or helping them create graphic organizers, such as matrices, that readily reveal lesson associations (Kiewra, 2012). Figure 3 shows a set of matrix notes about the psychology topic of reinforcement schedules.

Figure 3. Matrix notes for a lesson on reinforcement schedules.



Notice how easy this matrix makes it to identify *associations*, SOAR's third aspect; for example, (a) Ratio schedules are based on numbers, whereas interval schedules are based on time; (b) Ratio schedules produce rapid responding, whereas interval schedules produce slow responding; and (c) Fixed schedules are easy to extinguish, whereas variable schedules are difficult to extinguish.

SOAR's fourth aspect, *regulation*, involves students evaluating their own learning in advance of the actual test (or other assessment). Instructors can aid regulation by giving students retrieval practice (Karpicke, 2012), such as the following questions for reinforcement schedules: (a) Which schedule is associated with slow and steady responding?; (b) What is the result of extinction for a response learned on a variable schedule?; and (c) Every time a factory worker makes 5 widgets, she is paid $30. What schedule is this?

SOAR strategies work. Students studying SOAR materials that they helped create for a lesson on wildcats learned 29% more facts and 63% more associations than students using their own preferred study methods (Jairam & Kiewra, 2010).

Students who created their own SOAR study materials for a lesson on apes, following just 30 minutes of SOAR training, learned 8% more facts and 31% more associations than students who used their preferred study methods (Daher & Kiewra, 2016).

Conclusion

Most students record notes, which is good, because note taking serves both a process and product function. The bad news is that most students record only approximately one third of important lesson ideas, leaving them with woefully incomplete notes for review. Fortunately, there are several things instructors can do to boost note taking. Instructional strategies aimed at boosting note taking include providing complete notes, partial notes, or note-taking cues; re-presenting the lesson; providing pauses and revision opportunities; controlling laptop usage and cyber slacking; using PowerPoint slides effectively; and teaching note-taking skills. In addition, the SOAR strategy can help students transform their notes into optimal review materials and to SOAR to success. With all these options available, instructors should be able to vastly improve student note taking and review.

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References

Aguilar-Roca, N. M., Williams, A. E., & O'Dowd, D. K. (2012). The impact of laptop-free zones on student performance and attitudes in large lectures. *Computers & Education, 59*, 1300–1308. https://doi.org/10.1016/j.compedu.2012.05.002

Armbruster, B. B. (2000). Taking notes from lectures. In R. F. Flippo & D. C. Caverly (Eds.), *Handbook of college reading and study strategy research* (pp. 175–199). Mahwah, NJ: Lawrence Erlbaum Associates.

Austin, J. L., Lee, M., & Carr, J. P. (2004). The effects of guided notes on undergraduate students' recording of lecture content. *Journal of Instructional Psychology, 31*, 314–320.

Bassili, J. N., & Joordens, S. (2008). Media player tool use, satisfaction with online lectures and examination performance. *International Journal of E-Learning & Distance Education, 22*, 93–108.

Bauer, A., & Koedinger, K. R. (2007, April). Selection-based note-taking applications. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 981–990). ACM. https://doi.org/10.1145/1240624.1240773

Bligh, D. A. (2000). *What's the use of lectures?* San Francisco, CA: Jossey-Bass.

Bonner, J. M., & Holliday, W. G. (2006). How college science students engage in note-taking strategies. *Journal of Research in Science Teaching, 43*, 786–818. https://doi.org/10.1002/tea.20115

Boye, A. (2012). *Note-taking in the 21st century: Tips for instructors and students.* Texas Tech University, Teaching, Learning, and Professional Development Center.

Brown, C. M. (1999). *Human-computer interface design guidelines*. Exeter, UK: Intellect Books.

Bui, D. C., & Myerson, J. (2014). The role of working memory abilities in lecture note-taking. *Learning and Individual Differences, 33*, 12–22. https://doi.org/10.1016/j.lindif.2014.05.002

Castello, M., & Monereo, C. (2005). Students' note-taking as a knowledge-construction tool. *Educational Studies in Language and Literature, 5*, 265–285. https://doi.org/10.1007/s10674-005-8557-4

Chen, J., & Lin, T. F. (2008). Does downloading PowerPoint slides before the lecture lead to better student achievement? *International Review of Economics Education, 7*, 9–18. https://doi.org/10.1016/S1477-3880(15)30038-4

Colliot, T., & Jamet, E. (2018a). Does self-generating a graphic organizer improve students' learning? *Computers & Education, 126,* 13–22. https://doi.org/10.1016/j.compedu.2018.06.028

Colliot, T., & Jamet, E. (2018b). How does adding versus self-generating a hierarchical outline while learning from a multimedia document influence students' performances? *Computers in Human Behavior, 80*, 354–361. https://doi.org/10.1016/j.chb.2017.11.037

Colliot, T., & Jamet, E. (2018c). Does Viewing or (Totally or Partially) Self-Generating a Graphic Organizer Improve Students' Learning? *EARLI SIG 2 Comprehension of Text and Graphics, August, 27th-29th, Freiburg, Germany.*

Crawford, C. C. (1925). The correlation between lecture notes and quiz papers. *The Journal of Educational Research, 12*, 282–291.

Crooks, S. M., White, D. R., & Barnard, L. (2007). Factors influencing the effectiveness of note taking on computer-based graphic organizers. *Journal of Educational Computing Research, 37*(4), 369–391.

Daher, T., & Kiewra, K. A. (2016). An investigation of SOAR study strategies for learning from multiple online resources. *Contemporary Educational Psychology, 46*, 10–21. https://doi.org/10.1016/j.cedpsych.2015.12.004

Dietz, S., & Henrich, C. (2014). Texting as a distraction to learning in college students. *Computers in Human Behavior, 36*, 163–167.

Einstein, G. O., Morris, J., & Smith, S. (1985). Note-taking, individual differences, and memory for lecture information. *Journal of Educational Psychology, 77*(5), 522–532.

Emanuel, R. C. (2013). The American college student cell phone survey. *College Student Journal, 47*(1), 75–81.

Fink III, J. L. (2010). Why we banned use of laptops and scribe notes: our classroom. *American Journal of Pharmaceutical Education, 74*(6), 1–2.
Fisher, J. L., & Harris, M. B. (1973). Effect of note taking and review on recall. *Journal of Educational Psychology, 65*, 321–325. https://doi.org/10.1037/h0035640

Flanigan, A. E. (2018). *How instructional design, academic motivation, and self-regulated learning tendencies contribute to cyber-slacking?* (Unpublished doctoral dissertation). University of Nebraska, Lincoln.

Flanigan, A. E., & Kiewra, K. A. (2018). What college instructors can do about student cyber-slacking. *Educational Psychology Review*, *30,* 585–597. https://doi.org/10.1007/s10648-017-9418-2

Frey, B. A., & Birnbaum, D. J. (2002). *Learners' perceptions on the value of PowerPoint in lectures.* (ERIC Document Reproduction Service No. ED467192)

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers & Education, 50*, 906–914. https://doi.org/10.1016/j.compedu.2006.09.006

Froese, A. D., Carpenter, C. N., Inman, D. A., Schooley, J. R., Barnes, R. B., Brecht, P. W., et al. (2012). Effects of classroom cell phone use on expected and actual learning. *College Student Journal, 46*(2), 323–332.

Glover, J. A., Zimmer, J. W., Ronning, R. R., & Petersen, C. H. (1980). Nobody knows how to remember that prose. *The Journal of Educational Research*, *73*(6), 340–343.

Gubbels, P. S. (1999). College student studying: A collective case study. (Unpublished doctoral dissertation). University of Nebraska, Lincoln.

Gurrie, C., & Fair, B. (2010). Power Point—From fabulous to boring: The misuse of Power Point in higher education classrooms. *Journal of the Communication, Speech & Theatre Association of North Dakota*, *23*, 23–30.

Igo, L. B., Bruning, R., & McCrudden, M. T. (2005). Exploring differences in students' copy-and-paste decision making and processing: A mixed-methods study. *Journal of Educational Psychology, 97*(1), 103–116.

Igo, L. B., Bruning, R. H., McCrudden, M. T., & Kauffman, D. F. (2003). InfoGather: Six experiments toward the development of an online, data-gathering tool. In R. Bruning, C. A. Horn, & L. M. Pytlik-Zillig (Eds.), *Web-based learning: What do we know? Where do we go?* (pp. 57–77). Greenwich, CT: Information Age Publishing.

Igo, L. B., & Kiewra, K. A. (2007). How do high-achieving students approach web-based, copy and paste note taking? Selective pasting and related learning outcomes. *Journal of Advanced Academics, 18*(4), 512–529.

Igo, L. B., Kiewra, K. A., & Bruning, R. (2008). Individual differences and intervention flaws: A sequential explanatory study of college students' copy-and-paste note taking. *Journal of Mixed Methods Research, 2*(2), 149–168.
Jacoby, L. L. (1973). Encoding processes, rehearsal, and recall requirements. *Journal of Verbal Learning and Verbal Behavior, 12*, 302–310. https://doi.org/10.1016/S0022-5371(73)80074-X

Jairam, D., & Kiewra, K. A. (2010). Helping students soar to success on computers: An investigation of the SOAR study method. *Journal of Educational Psychology,* 102, 601–614. https://doi.org/10.1037/a0019137

Johnstone, A. H., & Su, W. Y. (1994). Lectures—A learning experience? *Education in Chemistry, 31*(3), 75–76.

Karat, C. M., Halverson, C., Horn, D., & Karat, J. (1999). Patterns of entry and correction in large vocabulary continuous speech recognition systems. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 568–575). New York: ACM. https://doi.org/10.1145/302979.303160

Karpicke, J. D. (2012). Retrieval-based learning: Active retrieval promotes meaningful learning. *Current Directions in Psychological Science, 21*, 157–163. https://doi.org/10.1177/0963721412443552

Katayama, A. D., & Crooks, S. M. (2003). Online notes: Differential effects of studying complete or partial graphically organized notes. *Journal of Experimental Education, 71*, 293–312. https://doi.org/10.1080/00220970309602067

Katayama, A. D., & Robinson, D. H. (2000). Getting students "partially" involved in note-taking using graphic organizers. *Journal of Experimental Education, 68*, 119–133.

Katayama, A. D., Shambaugh, R. N., & Doctor, T. (2005). Promoting knowledge transfer with electronic note taking. *Teaching of Psychology, 32*, 129–131.

Kiewra, K. A. (1985). Investigating notetaking and review: A depth of processing alternative. *Educational Psychologist, 20*, 23–32. https://doi.org/10.1207/s15326985ep2001_4

Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review, 1*, 147–172. https://doi.org/10.1007/BF01326640

Kiewra, K. A. (2009). *Teaching how to learn.* Thousand Oaks, CA: Corwin Press.

Kiewra, K. A. (2012). *Using graphic organizers to improve teaching and learning*. The IDEA Center. Retrieved from http://www.ideaedu.org/

Kiewra, K. A. (2016). Note taking on trial: A legal application of note-taking research. *Educational Psychology Review, 28*(2), 377–384.

Kiewra, K. A., & Benton, S. L. (1987). Effects of notetaking, the instructor's notes, and higher-order practice questions on factual and higher-order learning. *Journal of Instructional Psychology, 14*, 186–194.

Kiewra, K. A., & Benton, S. L. (1988). The relationship between information-processing ability and notetaking. *Contemporary Educational Psychology, 13*, 33–44.

Kiewra, K. A., Benton, S. L., Kim, S., Risch, N., & Christensen, M. (1995). Effects of note-taking format and study technique on recall and relational performance. *Contemporary Educational Psychology, 20*, 172–187.

Kiewra, K. A., Benton, S. L., & Lewis, L. B. (1987). Qualitative aspects of notetaking and their relationship with information processing ability. *Journal of Instructional Psychology, 14*, 110–117.

Kiewra, K. A., Mayer, R. E., Christensen, M., Kim, S.-I., & Risch, N. (1991). Effects of repetition on recall and note-taking: Strategies for learning from lectures. *Journal of Educational Psychology, 83*, 120–123. https://doi.org/10.1037/0022-0663.83.1.120

Knight, L. J., & McKelvie, S. J. (1986). Effects of attendance, note-taking, and review on memory for a lecture: Encoding vs. external storage functions of notes. *Canadian Journal of Behavioural Science, 18*, 52–61. https://doi.org/10.1037/h0079957

Kobayashi, K. (2005). What limits the encoding effect of note-taking? A meta-analytic examination. *Contemporary Educational Psychology, 30*, 242–262. https://doi.org/10.1016/j.cedpsych.2004.10.001

Kobayashi, K. (2006). Combined effects of note-taking/reviewing on learning and the enhancement through interventions: A meta-analytic review. *Educational Psychology, 26*, 459–477. https://doi.org/10.1080/01443410500342070

Kornhauser, Z. G. C., Paul, A. L., & Siedlecki, K. L. (2016). An examination of students' use of technology for non-academic purposes in the college classroom. *Journal of Teaching and Learning with Technology, 5*(1), 1–15.

Kuznekoff, J. H., & Titsworth, S. (2013). The impact of mobile phone usage on student learning. *Communication Education, 62*(3), 233–252.

Lauricella, S., & Kay, R. (2010). Assessing laptop use in higher education classrooms: The laptop effectiveness scale (LES). *Australasian Journal of Educational Technology, 26*(2), 151–163.

Locke, E. A. (1977). An empirical study of lecture note taking among college students. *Journal of Educational Research, 77*, 93–99. https://doi.org/10.1080/00220671.1977.10885044

Luo, L., Kiewra, K. A., Flanigan, A., & Peteranetz, M. (in press). Laptop versus longhand note taking: Effects on lecture notes and achievement. *Instructional Science.* https://doi.org/10.1007/s11251-018-9458-0
Luo, L., Kiewra, K. A., & Samuelson, L. (2016). Revising lecture notes: how revision, pauses, and partners affect note taking and achievement. *Instructional Science, 44*, 45–67. https://doi.org/10.1007/s11251-016-9370-4

Maddox, H., & Hoole, E. (1975). Performance decrement in the lecture. *Educational Review, 28*(1), 17–30.

Mayer, R. E. (2007). Research-based guidelines for multimedia instruction. *Reviews of Human Factors and Ergonomics, 3*, 127–147. https://doi.org/10.1518/155723408X299861

McCoy, B. R. (2013). Digital distractions in the classroom: Student classroom use of digital devices for non-class related purposes. *Journal of Media Education, 4*(4), 5–14.

McCoy, B. R. (2016). Digital distractions in the classroom phase II: Student classroom use of digital devices for non-class related purposes. *Journal of Media Education, 7*(1), 5–32.

Moore, J. C. (1968). Cueing for selective note taking. *Journal of Experimental Education, 36*, 69–72.

Mueller, P. A., & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological Science, 25*, 1159–1168. https://doi.org/10.1177/0956797614524581

Nye, P. A., Crooks, T. J., Powley, M., & Tripp, G. (1984). Student note-taking related to university examination performance. *Higher Education, 13*(1), 85–97.

Peper, R. J., & Mayer, R. E. (1978). Note taking as a generative activity. *Journal of Educational Psychology, 70*(4), 514–522.

Peper, R. J., & Mayer, R. E. (1986). Generative effects of note-taking during science lectures. *Journal of Educational Psychology, 78*, 34–38. https://doi.org/10.1037/0022-0663.78.1.34

Pettijohn, T. F., Frazier, E., Rieser, E., Vaughn, N., & Hupp-Wildsde, B. (2015). Classroom texting in college students. *College Student Journal, 49*(4), 513–516.

Peverly, S. T., Garner, J. K., & Vekaria, P. C. (2014). Both handwriting speed and selective attention are important to lecture note-taking. *Reading and Writing, 27*, 1–30. https://doi.org/10.1007/s11145-013-9431-x

Peverly, S. T., Vekaria, P. C., Reddington, L. A., Sumowski, J. F., Johnson, K. R., & Ramsay, C. M. (2013). The relationship of handwriting speed, working memory, language comprehension and outlines to lecture note-taking and test-taking among college students. *Applied Cognitive Psychology, 27*, 115–126. https://doi.org/10.1002/acp.2881

Piolat, A., Olive, T., & Kellogg, R. T. (2005). Cognitive effort during note taking. *Applied Cognitive Psychology, 19*, 291–312. https://doi.org/10.1002/acp.1086

Ragan, E. D., Jennings, S. R., Massey, J. D., & Doolittle, P. E. (2014). Unregulated use of laptops over time in large lecture halls. *Computers & Education, 62*, 24–31.

Rickards, J. P., & Friedman, F. (1978). The encoding versus the external storage hypothesis in note taking. *Contemporary Educational Psychology, 3*, 136–143. https://doi.org/10.1016/0361-476X(78)90020-6

Rickards, J. P., & McCormick, C. B. (1988). Effect of interspersed conceptual prequestions on note-taking in listening comprehension. *Journal of Educational Psychology, 80*(4), 592–594. https://doi.org/10.1037/0022-0663.80.4.592

Riley, J. D., & Dyer, J. (1979). The effects of notetaking while reading or listening. *Reading World*, *19*(1), 51–56. https://doi.org/10.1080/19388077909557514

Shrager, L., & Mayer, R. E. (1989). Note-taking fosters generative learning strategies in novices. *Journal of Educational Psychology, 81*, 263–264. https://doi.org/10.1037/0022-0663.81.2.263

Stacy, E. M., & Cain, J. (2015). Note-taking and handouts in the digital age. *American Journal of Pharmaceutical Education, 79*(7), 107, 1–6.

Stull, A. T., & Mayer, R. E. (2007). Learning by doing versus learning by viewing: Three experimental comparisons of learner-generated versus author-provided graphic organizers. *Journal of Educational Psychology, 99*(4), 808–820.

Suritsky, S. K., & Hughes, C. A. (1991). Benefits of notetaking: Implications for secondary and postsecondary students with learning disabilities. *Learning Disability Quarterly, 14*, 7–18. https://doi.org/10.2307/1510370

Susskind, J. E. (2005). PowerPoint's power in the classroom: enhancing students' self-efficacy and attitudes. *Computers & Education, 45*, 203–215. https://doi.org/10.1016/j.compedu.2004.07.005

Titsworth, B. S. (2004). Students' note taking: The effects of teacher immediacy and clarity. *Communication Education, 53*, 305–320. https://doi.org/10.1080/0363452032000305922

Titsworth, B. S., & Kiewra, K. A. (2004). Spoken organizational lecture cues and student notetaking as facilitators of student learning. *Contemporary Educational Psychology, 29*, 447–461. https://doi.org/10.1016/j.cedpsych.2003.12.001

Trevors, G., Duffy, M., & Azevedo, R. (2014). Note-taking within MetaTutor: Interactions between an intelligent tutoring system and prior knowledge on note-taking and learning. *Educational Technology Research and Development, 62*(5), 507–528.

Van Meter, P., Yokoi, L., & Pressley, M. (1994). College students' theory of note taking derived from their perceptions of note taking. *Journal of Educational Psychology, 86*, 323–338. https://doi.org/10.1037/0022-0663.86.3.323

Wong, L. (2014). *Essential study skills* (8th ed.). Stamford, CT: Cengage Learning.

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