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Note-Taking Interventions for College Students: A Synthesis and Meta-Analysis of the Literature

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ABSTRACT

Although note taking is frequently described as an important skill for postsecondary success, there have been few note-taking intervention studies involving multiple sessions spanning more than one week. In a systematic search, we identified seven peer-reviewed articles reporting 10 intervention studies published from 1990–2014. The only single-case design study addressed taking notes from texts, but four treatment-comparison studies that taught note taking during lectures assessed students' abilities when taking notes from texts. The remaining four treatment-comparison and one single-group design studies focused solely on note taking during lectures. Three types of notes were represented in the corpus: guided (seven studies), split-page (two studies), and self-restructured (one study). In comparing students who did and did not receive note-taking instruction, Hedges's *g* effect sizes on outcome measures of content learning and note quality ranged from −0.35 to 2.11. Across nine group design studies, the weighted average effect was 0.54 (CI_{95} = 0.47 to 0.62). The weighted average Tau-U of the single-case design was 1.00 (CI_{95} = 0.60 to 1.40).

KEYWORDS

note taking
college
instructional strategies
meta-analysis

The traditional college lecture format has been characterized as ineffective because it relies on transmitting information to students rather than actively involving them in their learning or in exploration of content (e.g., Moust, Van Berkel, & Schmidt, 2005; Strobel & van Bareneveld, 2009). But contrary to claims that students in traditional lectures are passive, those surveyed believe they have worked hard in such classes and learned content they can retain and use over time (Covill, 2011). This may be because students commonly engage in taking notes, regardless of whether they are told to do so (Williams & Eggert, 2002).

Note-Taking Skill

Note taking is a decidedly active and multifaceted skill that requires academic listening to attend to a speaker purposefully (Gur, Dilci, Coskun, & Delican, 2013), working memory to hold and organize information taken in visually or aurally (Bui & Myerson, 2014), and the ability to record pertinent ideas quickly (Peverly et al., 2007). Information in a course may

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be communicated through an oral lecture, on electronic slides, or through digital and print media. Students may be responsible for synthesizing all these sources in their assignments or assessments. Even in flipped classes (i.e., those in which students prepare themselves through electronically delivered lectures or readings so that their actual class time is spent on activities) students are held accountable for the content such as through the use of quizzes (DesLauriers, Schelew, & Wieman, 2011; Lage, Platt, & Treglia, 2000). Hence, both flipped and traditional college courses require students to process information delivered orally, in print, and electronically so that they can use that information to support their learning.

In fact, the act of writing down information, or encoding it in print, is believed to benefit recall (Kobayashi, 2005) as well as provide an external memory store for later rehearsal (Eskritt, Lee, & Donald, 2001). Those not taking notes have been found to have difficulties understanding and recalling information as well as lower test performance (Armbruster, 2009; Gur et al., 2013). Yet, many postsecondary students acknowledge having difficulty with the task (Rachal, Daigle, & Rachal, 2007). Previous research has found that they record less than half of the important information (Baker & Lombardi, 1985). This may be attributable to difficulties with recording information quickly or efficiently such as by paraphrasing and using abbreviations (Hughes & Suritsky, 1994; O'Donnell & Dansereau, 1993; Piolat, Olive, & Kellogg, 2005). Examinations of notes that are associated with better content learning suggest higher quality notes are not only more complete, but also well organized with a macrostructure and clear relationships between main ideas and supporting details (Kiewra & Fletcher, 1984). Students with poorer quality notes can have difficulty understanding what they managed to record when they return to their notes later (Williams & Eggert, 2002). Unfortunately, few who struggle are directly taught strategies for taking notes successfully (Hadley, 2007).

Note-Taking Instruction

Attempts to improve students' note taking have focused alternately on component skills, a combination of skills and different ways of formatting or arranging the information on the page, or the note-taking formats alone. We describe each of these approaches in the sections that follow within the context of a particular example.

Skills Approach: Self-Restructured Notes

Skills approaches to note-taking instruction involve (a) teaching students academic listening strategies for discerning important versus irrelevant information during a lecture, (b) techniques for improving their efficiency in recording the auditory and visual content, and (c) methods for checking their understanding by synthesizing and connecting information after taking notes (Armbruster, 2009). The latter of the three skills may involve *self-restructuring* in which students return to their notes to correct inaccuracies or fill in gaps as well as ensure that they understood the material by asking themselves questions about the content and the process they used to record it (Berry & Chew, 2008).

Taking notes requires cognitive effort to be split among comprehending what is being heard or read, writing important information, and learning the content for later use. It has been suggested that the strain these multiple pressures place on cognitive resources forces note takers to choose between comprehending information at the expense of recording it or

transcribing information at the expense of processing it (Piolat et al., 2005). Transcribing has the benefit of creating an external memory store (Kiewra, 1987; Peverly et al., 2007; Peverly & Sumowski, 2012), but to comprehend and learn from that information, it must be restructured in much the same way that rough drafts of other written products are revised. That is, repetitively reviewing poor quality notes would not be expected to produce the same kind of gains as self-restructuring, or actively processing and deliberately practicing the content of the notes (e.g., clarifying points, summarizing). This is consistent with research that has found that the amount of time spent studying was associated with improved academic performance only when the time was spent on effective studying techniques (Plant, Ericsson, Hill, & Asberg, 2005).

Students who wrote summaries after taking notes have demonstrated better performance than those who did not, and students who only reviewed their notes without writing summaries had no significant difference in content learning from those who did not review their notes at all (Davis & Hult, 1997). Self-restructuring skills are among those that need to be taught to students who struggle to take and use notes effectively. However, note-taking skills instruction has not resulted in quick improvements (Flippo & Caverly, 2000), so another approach has been to combine the teaching of general note-taking skills with the use of particular note templates.

Combining Skills and Format: Split-Page Notes

Split-page notes involve recording the main points of a lecture or reading in a narrow column down the left side of the page and the facts and details in a wider column down the right side of the page (Palmatier, 1973; Pauk, 1989). Pauk's (1989) format was intended to mirror the linear structure of traditional lectures and texts, and he recommended it be implemented within a six-step process that incorporates various note-taking skills, including those involved in self-restructuring: recording notes, formulating questions that can be answered with the notes, reciting information, reflecting on the ideas and how to apply them, reviewing the notes regularly, and recapitulating or summarizing the information. Taking notes in a columnar format has been considered advantageous for helping students who have difficulty dealing with large amounts of information to organize what they glean from lectures and written material in a way that reflects the relationship between the superordinate and subordinate ideas (Saski, Spicewood, & Carter, 1983). The approach has been effective at improving learning from social studies and science texts immediately, on transfer tasks, and in maintenance conditions (Horton, Lovitt, & Christensen, 1991).

Adding the split-page format likely would not reduce the length or intensity of instruction needed to acquire the necessary note-taking skills. Rather, it may involve more time to teach students how to use the organizational format and perform each of the steps in the process. Hence, the third approach to note-taking instruction has been to assume that students have poor note-taking ability and, thus, increase the support provided to them in the format of the notes.

Note Format Approach: Guided Notes

One focus of note-taking templates has been on *guided notes*, or partially completed notes provided by the instructor in advance of the lecture. These are intended to alleviate the trade-off in cognitive effort allocation for comprehending or recording information

(Collingwood & Hughes, 1978). The amount of missing content that students need to complete during a lecture, activity, or reading can be left constant or can be gradually increased in an effort to shift greater responsibility to students. Although dependent upon instructors to create, guided notes are believed to increase the amount of time students have to think about the information being presented or read and to improve the overall organization, accuracy, and completeness of their notes (Barbetta & Skaruppa, 1995). College students given consistent skeletal outlines have performed better than students who were simply exposed to the completed outline (Austin, Gilbert, Thibeault, Carr, & Bailey, 2002).

However, some have argued that notes organized linearly in an outline do not make obvious the relationships among ideas, so researchers have recommended guided notes be prepared in matrix formats or as concept maps that arrange information spatially to depict the associations (Berry & Chew, 2008; Jairam & Kiewra, 2009). Research on guided notes has found that postsecondary students who were provided with partially completed graphic organizers outperformed those who received outlines or completed graphic organizers (Katayama & Robinson, 2000).

Previous Systematic Reviews of the Literature

Unfortunately, many studies of note taking offer a point-in-time examination, that is, students are exposed to an approach once or twice and then tested (e.g., Austin et al., 2002; Gur et al., 2013). This may reveal what students are able to do at the moment but not what they might gain from extended instruction in note taking. In addition, students' motivation and study habits can change over a semester-long course (Zusho, & Pintrich, 2003), so it seems important to understand how their use of particular note-taking types affects their content learning over time. Existing reviews of the literature have not addressed note-taking interventions in this manner.

One systematic review examined the encoding effect of note taking on learning outcomes, but the purpose was not to determine whether instruction could improve students' abilities (Kiewra, 1987). Two meta-analyses conducted by Kobayashi (2005, 2006) explored the role of interventions on the effects of both note taking and note reviewing of provided notes. However, interventions might have been a one-time verbal direction to take notes a certain way, as opposed to purposeful instruction in how to take notes. In addition, for 35 of the 44 independent samples examined by Kobayashi (2006), completed notes were provided to participants. The effects were moderate (0.41), as compared to the small effect of not providing notes (0.19), but were not based on investigations of the practice over an extended period of time. Giving students complete notes also was supported by the authors of a narrative review (Maydosz & Raver, 2010). A combination of descriptive, correlation, factor analytic, and intervention studies were included in the corpus of 41 articles, but the authors did not systematically code study features or compute effect sizes.

Purpose and Research Question

We sought to conduct a synthesis of the note-taking literature that would differ from previous reviews in the following ways. First, we were interested in exploring the effects that extended note-taking instruction would have on students' content learning, so we defined *intervention* as more than a verbal direction or limited pretraining exercises and excluded research designs that

did not allow for causal inferences. Second, although students have expressed a preference for being given the instructor's notes (Landrum, 2010; Murphy & Cross, 2002), the practice would undermine active learning while reading course texts and during online or in-person lectures, thus threatening to increase student dependence on instructors telling them what they need to know (Machemer & Crawford, 2007). Therefore, we clearly distinguished *note taking* from *note reviewing*, excluding the latter where it was not an accompaniment to the note-taking instruction. In other words, studies could not exclusively teach students to review provided notes but had to teach students how to take notes for themselves. Students' own products could then be reviewed.

The third way in which our systematic review differs from previous work is that we planned to analyze the different types of note taking present in the literature. This was because self-restructured, split-page, and guided notes require different levels of student and instructor responsibility, so we purposefully coded the features of the students, instructors, and interventions to inform our interpretation of the results. The research question addressed was: What are the effects of extended note-taking instruction on college students' content learning?

Methods

Relevant studies were identified in a two-stage process informed by recent reviews of note-taking interventions at the postsecondary level (Kobayashi, 2006; Maydosz & Raver, 2010). First, we searched electronic databases (i.e., *Academic Search Complete, Dissertation Abstracts, ERIC, ProQuest Dissertations and Theses*, and, *PsycINFO*) using the search terms: note taking, note-taking, notetaking, lecture note*. Second, we conducted an ancestral search of the previous reviews. Because the nature of note taking has shifted over the last two decades from a basis in traditional lectures to one that incorporates more electronic slides and web-based content (DesLauriers et al., 2011; Lage et al., 2000), the publication date range was restricted to 1990 through August 2014. This shift in note taking also has redefined *lecture*. Because students may be required to take notes outside of class and from print or digital content, the search was inclusive of oral, written, and electronic delivery of information on which students were expected to take notes.

The 2,547 abstracts identified were evaluated by the following criteria: (a) participants of all ages were included as long as they were enrolled in an institute of higher learning; (b) studies were accepted regardless of the country in which they were conducted or the primary language spoken by the participants; (c) the study provided participants extended instruction in taking notes, which we defined as multiple treatment sessions spanning more than one week; (d) at least one outcome measure assessed content learning; and (e) the authors reported sufficient data for computing effect sizes. In addition, we accepted studies teaching note taking in any context (e.g., on traditional lectures or written course materials) and allowed for experimental, quasi-experimental, within-group, and single-case research designs in order to capture as many studies as possible within the established time period.

Of the abstracts initially identified, 99.3% ($n = 2{,}528$) were omitted because they were not studies of extended note taking (i.e., criterion [c] above). Rather, studies were descriptive, correlational, or limited to note reviewing or pretraining exercises. Ten other studies were omitted because they were conducted with students in middle or high school (i.e., criterion [a] above), and two studies conducted with postsecondary students were omitted because the authors did not provide sufficient data for computing effect sizes associated with the note-taking instruction (i.e., criterion [e]).

Due to concern about publication bias (Francis, 2014), we had intended to include the gray literature (i.e., reports and dissertations not published in academic journals), but the initial search strategies yielded no books, dissertations, monographs, or reports meeting criteria. Furthermore, there was no pattern in the type of peer-reviewed journals publishing studies that did meet criteria, so we could not determine a prominent outlet to search manually. Hence, our search concluded with seven articles reporting 10 studies: one single-case, one single-group, and eight treatment-comparison designs.

Coding and Reliability

Two members of the research team (one faculty researcher and one graduate assistant) independently coded five studies chosen at random (50% of the corpus) for the characteristics of the participants, settings, instructors, methodological designs, interventions, comparison conditions (if applicable), and outcomes. The number of agreements between the two raters divided by the total number of codes revealed a 94% inter-rater reliability for those five studies. Therefore, one researcher coded the five remaining studies in the corpus.

Effect Size Calculations

All nine group design studies provided means and standard deviations for the outcomes of interest, but there was a wide range in the sample sizes. Therefore, we calculated Hedges's *g* effect sizes (Hedges, 1981) for each of the 25 total comparisons in group designs: one within-subjects, four treatment-treatment, and 20 treatment-control comparisons. We used the effect sizes and their standard errors to calculate a weighted average effect size for all group designs combined, using the formula recommended by Lipsey and Wilson (2001) in which studies are weighted by their inverse variance. For the single-case design, we calculated Tau-U effect sizes for each of the three participants to account for increases in baseline (Parker, Vannest, Davis, & Sauber, 2011). This also allowed us to determine the weighted average Tau-U within a 95% confidence interval (Vannest, Parker, & Gonen, 2011).

Results

Study Participants

Across the 10 studies, there were a total of 1,801 participants (see Table 1). Excluding the single-case design ($N = 3$; Lazarus, 1993) and the largest group design ($N = 1{,}002$; Narjaikaew, Emarat, & Cowie, 2009), the other eight studies had more comparable samples with a range of 58 (Robinson et al., 2006 [study 1]) to 120 participants (Robinson et al., 2006 [study 2]), a mean of 100, and a median of 108 (Rahmani & Sadeghi, 2011; Tsai & Wu, 2010). Participants were all undergraduates, but the mean age was reported only by Lazarus (1993; $M = 24.33$) and Spires (1992; $M = 18.8$). Seven of the eight studies providing information about participants' gender indicated that more women than men were enrolled (Rahmani & Sadeghi, 2011; Robinson et al., 2006; Spires, 1992; Tsai & Wu, 2010).

Two studies provided other demographic data about participants. Spires (1992) reported participants' race/ethnicity, where a majority (68%) of the students recruited from a required reading and learning strategies course were African American, and Lazarus (1993) reported

Table 1. Study participants and settings.

Study	Number of participants	Age or rank in college	Demographic characteristics*	How participants selected	Setting
			Single-case design		
1. Lazarus (1993)	$N = 3$	Average age = 24.33	2 Males with LD 1 Female without LD	Enrolled in introductory psychology course	State university in the midwestern United States; training conducted in private office; students completed notes in library study carrels; lectures and quizzes delivered in psychology class
			Treatment-comparison designs		
2. Narjaikaew et al. (2009)	$N = 1{,}002$ (665 T; 337 C)	First year university students	NR	Enrolled in introductory physics courses (from schools of science or engineering) held in the second semester of the academic years 2005 and 2007	State university in the northeastern region of Thailand; lecture halls with seating for more than 200 students
3. Rhamani & Sadeghi (2011)	$N = 108$ (48 T; 60 C)	Undergraduates	40 Males (18 T; 22 C) 68 Females (30 T; 38 C)	Undergraduate students majoring in English-language translation, scoring within +/−1 *SD* of the mean on the Michigan Test of English Language Proficiency, reading comprehension	University classrooms in Iran
4. Robinson et al. (2006) Study 1	$N = 114$ (54 T; 60 C)	Undergraduates	Enrollment was typically 90% female	Enrolled in educational psychology course	State university in southern United States
5. Robinson et al. (2006) Study 2	$N = 120$ (60 T; 60 C)	Undergraduates	Enrollment was typically 90% female	Enrolled in educational psychology course	State university in southern United States
6. Robinson et al. (2006) Study 3	$N = 110$ (61 T; 49 C)	Undergraduates	Enrollment was typically 90% female	Enrolled in educational psychology course	State university in southern United States
7. Robinson et al. (2006) Study 4	$N = 58$ (29 T first; 29 T second)	Undergraduates	Enrollment was typically 90% female	Enrolled in educational psychology course	State university in southern United States

(*Continued on next page*)

Table 1. (*Continued*)

Study	Number of participants	Age or rank in college	Demographic characteristics*	How participants selected	Setting
8. Spires (1992)	$N = 99$ (35 T1; 34 T2; 30 C)	Freshmen Mean age = 18.8	68% African American; 25% White; 7% Hispanic and Asian 49% Male 51% Female	Required to take a reading and learning strategies course based on low SAT verbal scores	Major university in southeastern United States
9. Tsai & Wu (2010)	$N = 108$ (54 T; 54 C)	Freshmen	28 Males 80 Females	English majors with higher intermediate and lower advanced English proficiency scores on college entrance exam; Completed more than eight years of English coursework	Higher education institute in the central part of Taiwan
		Single-group design			
10. Cohen et al. (2013)	$N = 79$	Mostly undergraduate junior and senior psychology majors	NR	Enrolled in a college social psychology research methods course	Large, selective-admission state university

*Demographic characteristics of participants might include gender, race/ethnicity, disability category. *Notes*. C = comparison; LD = learning disability; *N* = sample size; NR = not reported; *SD* = standard deviation; T = treatment.

that two of the three students had a learning disability. In most cases, participant selection was based on enrollment in targeted courses and not necessarily purposeful to ensure certain student characteristics. The exceptions were two studies addressing the note-taking performance of students with proficiency in English as a foreign language (Rahmani & Sadeghi, 2011; Tsai & Wu, 2010). These were set in Iran and Taiwan, respectively. The third study that took place outside the United States was in a different region of Taiwan (Narjaikaew et al., 2009) but was concerned with student performance in introductory physics courses where English skills were not relevant.

Instructor Characteristics

As shown in Table 2, the typical course instructors were responsible for delivering both the note-taking and content instruction in eight studies (Cohen, Kim, Tan, & Winkelmes, 2013; Rahmani & Sadeghi, 2011; Robinson et al., 2006; Spires, 1992; Tsai & Wu, 2010). These instructors were or included the researchers, so implementation was occurring within the students' usual class setting, structure, and time. In the other two studies, the researchers delivered the note-taking instruction, and the typical course instructor delivered the content instruction (Lazarus, 1993; Narjaikaew et al., 2009). Treatment integrity was not reported in nine of the ten studies. Lazarus (1993) described how the three students' adherence to the note-taking procedures was monitored, but not the instructor's fidelity. No studies reported the training of the instructors, likely due to the fact that the researchers were delivering the instruction themselves.

Table 2. Instructor characteristics and treatment integrity.

Study	Instructor	Treatment integrity monitoring
	Single-case design	
1. Lazarus (1993)	Researcher delivered note- taking training; regular course instructor delivered lectures and quizzes	Students showed their notes to the librarian before gaining access to the "key." Researcher checked study carrel logs and four chapters of the participants' guided notes for completion and accuracy. Participants 1 and 3 had 100% of the notes. Participant 2 had three chapters accurate, but the chapter for quiz 12 was incomplete.
	Treatment-comparison designs	
2. Narjaikaew et al. (2009)	*T*: Researcher *C*: Typical course instructor	NR
3. Rhamani & Sadeghi (2011)	Typical course instructors	NR
3. Robinson et al. (2006), Study 1	Typical course instructor	NR
4. Robinson et al. (2006), Study 2	Typical course instructor	NR
5. Robinson et al. (2006), Study 3	Typical course instructor	NR
6. Robinson et al. (2006), Study 4	Typical course instructor	NR
7. Spires (1992)	Typical course instructors	NR
8. Tsai & Wu (2010)	Typical course instructor	NR
	Single-group design	
9. Cohen et al. (2013)	Typical course instructor	NR

Notes. C = comparison; LD = learning disability; NR = not reported; T = treatment.

Study Characteristics

The features of the 10 studies in the corpus are displayed in Table 3 with the outcomes measures in Table 4. Here we summarize the way in which participants were assigned to treatments, the type of note taking they were taught, the number and length of the instructional sessions, and the means by which changes to students' note-taking abilities were assessed.

Participant Assignment

The single-case research employed a multiple baseline across participants design. Students were sequentially introduced to treatment with one intervention data point lag between replications. Of the nine group designs, one had students serve as their own controls by randomly assigning them to receive note-taking instruction in particular weeks and then comparing their performance on midterm exam questions that were drawn from the treatment weeks to those from the control weeks (Cohen et al., 2013). The other eight group designs were treatment comparisons with seven of those randomly assigning intact classes to treatment (Narjaikaew et al., 2009; Rahmani & Sadeghi, 2011; Robinson et al., 2006 [studies 1–3]; Spires, 1992; Tsai & Wu, 2010). The eighth treatment-comparison study employed a crossover design with students randomly assigned to receive the treatment first or second (Robinson et al., 2006 [study 4]).

Type of Note Taking

Although there were no search restrictions regarding the means of delivering the content on which students were to take notes, most studies ($n = 9$) taught note taking in the context of in-person lectures. Only one study focused on taking notes from textbooks (Lazarus, 1993), and no studies included note-taking from online material. It should be noted that lecture note taking often included written or digital information projected to the class, so students would have been required to apply skills flexibly.

There were three types of note-taking instruction represented in the research. The most commonly implemented approach was guided notes ($n = 7$ studies). Within this category, the format of the notes was most often a graphic organizer with content left blank for students to complete (Rahmani & Sadeghi, 2011; Robinson et al., 2006). Researchers gradually increased the blanks on the organizers as students were expected to improve their skill in taking notes. Narjaikaew et al. (2009) used a similar format of notes in that the information was displayed in boxes with key information and graphics accompanied by questions or problems that students were to complete. However, these differed from the graphic organizer studies in three ways: (a) the authors referred to the guided notes as *activity sheets* and *worksheets*, (b) the amount of content provided was not systematically faded, and (c) the instructor presented the solutions in class so that students could copy or correct their notes. Lazarus (1993) also allowed students to access completed versions of the notes after they had attempted to take the notes on their own, but this study was unique in that it used a linear outline format for the guided notes and required students to work from textbooks in the library rather than taking notes from information presented in the targeted class—the medium used in the other nine studies.

Two studies did not rely on a template provided by the researchers but taught students to take notes in a split-page format (Spires, 1992; Tsai & Wu, 2010). Both studies offered instructor modeling and weekly feedback, but the researchers did not indicate that

Table 3. Study characteristics.

Study and type of notes	Assignment of participants	Description of condition(s)	Sessions	Assessment of note-taking quality
		Single-case design		
1. Lazarus (1993) Type of notes: Guided outline	N/A	Baseline: Students took notes in their typical fashion. T: Students received individual instruction in note taking and were provided guided notes that included main ideas, related terms in sequence, and blank spaces for students to complete. The researcher modeled using highlighted chapter information in the notes. Then, students practiced completing the blank spaces for a highlighted chapter before receiving feedback. Finally, they practiced using guided notes with an unhighlighted chapter. After individually completing weekly guided notes, students compared them to a "key." Two weeks later, students met with researcher, explained how they were using the notes, and received feedback on their notes.	Number of sessions: Participant 1 = 16; Participants 2 and 3 = 15 Frequency of sessions: weekly Length of sessions: Training = 2 hours; Other sessions = NR	None
Treatment-comparison designs				
2. Narjaikaew et al. (2009) Type of notes: Guided worksheet	Based on year of enrollment: academic year 2005 = C; academic year 2007 = T	T: Students received activity sheets for observations of demonstrations and guided notes worksheets with facts, key points, pictures and diagrams, conceptual questions, calculation questions or problem items, and blank spaces to complete. The instructor demonstrated how to use the notes, solve problems, and write information and equations in blank spaces while students copied or corrected the solutions. C: The instructor explained information, asked questions, and demonstrated how to solve problems, writing down important information on transparencies. Students did not receive handouts but took notes in their typical fashion.	Number of sessions: NR (Control group throughout second semester of 2005; Treatment group for two weeks of the 2007 semester) Frequency of sessions: NR Length of sessions: NR	None

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Table 3. (*Continued*)

Study and type of notes	Assignment of participants	Description of condition(s)	Sessions	Assessment of note-taking quality
3. Rhamani & Sadeghi (2011) Type of notes: Guided graphic organizers	Random assignment of classes to treatment	T: Students received graphic organizers and were taught techniques to improve their note-taking efficiency (e.g., identifying a purpose and significant information, paraphrasing, underlining possible test information, using abbreviations, and symbols). The instructor read textbook passages aloud, displayed the graphic organizer, and helped students complete the blanks. Blanks were gradually increased until the organizers were completely blank (sixth session). C: Students took notes in their typical fashion.	Number of sessions: 8 Frequency of sessions: 2 times/week × 2 months Length of sessions: 30 minutes	Number of words, main ideas, supporting details, omissions
4. Robinson et al. (2006) Study 1 Type of notes: Guided graphic organizers	Random assignment of classes to treatment	T: Students were given six sets of partially completed graphic organizers (one for every two chapters) and told that the notes contained information on quizzes. The first notes had one fourth of the content deleted for students to complete. Gradually more content was deleted until the last notes had only one column heading. C: Students were given six sets of fully completed graphic organizers (one for every two chapters) and told that the notes contained information on quizzes.	Number of sessions: NR (15 week course) Frequency of sessions: 2 times/week Length of sessions: NR	Change in note-taking style from linear to graphic
5. Robinson et al. (2006) Study 2 Type of notes: Guided graphic organizers	Random assignment of classes to treatment	T: Students were given 18 partially completed graphic organizers for 12 textbook chapters and told that the notes contained information on quizzes. The first notes had one fourth of the content deleted. Gradually more content was deleted until the last notes had only one column heading. After completing the notes on paper, students had one opportunity to select options to complete the empty cells in a computer version of the notes. C: Students were given 18 fully completed graphic organizers for 12 chapters of the textbook and told that the notes contained information on six quizzes.	Number of sessions: NR (15 week course) Frequency of sessions: 2 times/week Length of sessions: NR	Change in note-taking style from linear to graphic

6. Robinson et al. (2006) Study 3 Type of notes: Guided graphic organizers	Random assignment of classes to treatment	T: Students were given six sets of partially completed graphic organizers (one for every two chapters) and told that the notes contained information on quizzes. The first notes had one fourth of the content deleted for students to complete. Gradually more content was deleted until the last notes had only one column heading. C: Students were given 18 fully completed graphic organizers for 12 chapters of the textbook and told that the notes contained information on six quizzes.	Number of sessions: NR (T = 15 week term; C = 5 week term) Frequency of sessions: T = 2 times/week; C = 5 times/week Length of sessions: NR	Change in note-taking style from linear to graphic
7. Robinson et al. (2006) Study 4 Type of notes: Guided graphic organizers	Random assignment of students to receive treatment first or second (experimental crossover design)	T first: Students were given 11 partially completed graphic organizers for the first three units (six chapters) and told that the notes contained information on quizzes. The first notes had one fourth of the content deleted for students to complete. Gradually more content was deleted until the notes had only one column heading. T second: Students were given seven partially completed graphic organizers for the last three units (six chapters). Other procedures were the same as T first. C first: Students were given 11 fully completed graphic organizers for the first three units (six chapters) and told that notes contained information on quizzes. C second: Students were given seven fully completed graphic organizers for the last three units (six chapters). Other procedures were the same as C first.	Number of sessions: NR (15 week course) Frequency of sessions: 2 times/week Length of sessions: NR	Change in note-taking style from linear to graphic
8. Spires (1992) Type of notes: Split-page	Random assignment of classes to treatment	T1: Students listened to videotaped lectures to learn the split-page method and how to differentiate between main ideas (left side) and supporting details (right side). The instructor explained the importance of the strategy, modeled how to take notes, and explained why information was a main idea or detail and why points were omitted or combined. Students then participated in guided practice as the instructor assisted and provided feedback. Guided feedback continued until students achieved independence. T2: Same as T1 but added self-questioning to monitor note	Number of sessions: NR (5 weeks) Frequency of sessions: NR Length of sessions: NR (10 hours total)	Holistic rating of note format (split-page style, legibility, and abbreviations of recurring words) and content (accuracy of main points,

(*Continued on next page*)

Table 3. (*Continued*)

Study and type of notes	Assignment of participants	Description of condition(s)	Sessions	Assessment of note-taking quality
		taking. Students asked themselves questions about planning before lecture (What is my purpose in listening to lecture?); monitoring during lecture (Am I maintaining concentration?), and evaluating after lecture (Did I deal with comprehension failures?). C: Students viewed videos and were taught how to use the split-page note-taking method but did not receive any modeling, guided practice, or self-questioning strategies.		accuracy of details, sequence, clarity)
10. Tsai & Wu (2010) Type of notes: Split-page	Random assignment of classes to treatment; assignment of students to language based on even/odd seat number	T: The instructor demonstrated how to record main ideas and details on the split page and then write paragraphs to summarize the passage. Each week, the instructor taught note taking and offered to answer questions or teach techniques after class. Students in even-numbered seats took notes in English, and those in odd-numbered seats took notes in Chinese. C: Students took notes in their typical fashion. Those in even-numbered seats took notes in English, and those in odd-numbered seats took notes in Chinese.	Number of sessions: 14 Frequency of sessions: weekly Length of sessions: Training = 2 hours; Other sessions = 15 min of the 2-hour class	None
		Single-group design		
11. Cohen et al. (2013) Types of notes: Self-restructured	Random assignment to treatment weeks by student identification number (served as own controls)	T: The instructor explained the purpose, format, and criteria for success with restructuring notes. The assignments included three steps: (a) type restructured notes from lecture to ensure accuracy, completeness, clarity, and coherence; (b) summarize main point of lecture in 30 words or less; (c) select one detail from the class and describe it in approximately 150 words, relating it to an important point from the lecture. C: Students took notes in their typical fashion but did not complete the restructuring assignment.	Number of sessions: 5 Frequency of sessions: once a week Length of sessions: 2 hours	None

Notes. C = comparison; CSEM = conceptual survey of electricity and magnetism; N/A = not applicable; NR = not reported; T = treatment; TOEFL = Test of English as a Foreign Language.

Table 4. Outcome measures, means, and standard deviations.

Study	Outcome measure(s)
Single-case design	
1. Lazarus (1993)	**Weekly content quizzes (intervention)** Student 1: $M = 87.72\%$ Student 2: $M = 87.72\%$ Student 3: $M = 90.5\%$ **Final exam** Student 1: $M = 82\%$ Student 2: $M = 87\%$ Student 3: $M = 84\%$
Treatment-comparison designs	
2. Narjaikaew et al. (2009)	**CSEM** T: $M = 3.34$ (1.60) C: $M = 2.34$ (1.42)
3. Rhamani & Sadeghi (2011)	**TOEFL immediate** T: $M = 21.89$ (3.53) C: $M = 19.44$ (3.11) **TOEFL delayed** T: $M = 21.92$ (2.06) C: $M = 20.19$ (2.19)
4. Robinson et al. (2006) Study 1	**Content quizzes** T: $M = 138.62$ (11.94) C: $M = 133.13$ (12.40)
5. Robinson et al. (2006) Study 2	**Content quizzes** T: $M = 140.31$ (10.86) C: $M = 134.08$ (10.50)
6. Robinson et al. (2006) Study 3	**Content quizzes** T: $M = 145.05$ (12.20) C: $M = 140.00$ (12.30)
7. Robinson et al. (2006) Study 4	**Content quizzes** T1: $M = 75.14$ (9.25) C1: $M = 70.00$ (8.80) T2:: $M = 73.24$ (8.08) C2:: $M = 74.38$ (8.59)
8. Spires (1992)	**Immediate content quizzes** T1: $M = 11.50$ (1.50) T2:: $M = 14.67$ (1.56) C: $M = 11.25$ (1.64) **Delayed content quizzes** T1: $M = 10.44$ (1.55) T2:: $M = 11.11$ (1.57) C: $M = 10.19$ (1.66) **Immediate content summary writing** T1: $M = 1.83$ (1.23) T2:: $M = 1.90$ (1.52) C: $M = 1.76$ (1.67) **Delayed content summary writing** T1: $M = 1.35$ (1.14) T2:: $M = 1.21$ (1.19) C: $M = 1.62$ (1.11)
9. Tsai & Wu (2010)	**Short conversations (full sample)** T: $M = 17.80$ (1.73) C: $M = 16.76$ (2.09) **Short conversations (English notes)** T: $M = 18.22$ (1.89) C: $M = 17.48$ (2.17) **Short conversations (Chinese notes)** T: $M = 17.37$ (1.47) C: $M = 16.04$ (1.76) **Long lectures (full sample)**

(*Continued on next page*)

Table 4. (*Continued*)

Study		Outcome measure(s)
		T: $M = 16.04$ (1.78) C: $M = 14.37$ (2.25)
	Single-group design	
10. Cohen et al. (2013)		**Content exam** T: $M = 72\%$ (25%) C: $M = 61\%$ (14%)

Note. C = comparison; CSEM = conceptual survey of electricity and magnetism; N/A = not applicable; NR = not reported; T = treatment; TOEFL = Test of English as a Foreign Language.

completed versions of notes were revealed to students. The Spires study was the only one in the corpus that included a second treatment in addition to the comparison condition. Students assigned to the second treatment group received split-page notes plus self-questioning instruction, as opposed to the split-page instruction alone in the first treatment. The questions were designed to help students monitor their note taking by setting a purpose, checking their concentration during videotaped lectures, and evaluating how they handled any breakdowns in their understanding of the lecture content.

The final study in the corpus did not attempt to impose a note-taking style on students but taught students how to restructure whatever notes they took (Cohen et al., 2013). This approach involved fixing up the notes for accuracy, completeness, clarity, and coherence before summarizing the main point of the lecture in 30 words and describing a detail in 150 words. Students may have been taking notes in all classes, but the restructuring components were completed and submitted only during assigned weeks. Restructuring took place outside of class, using the notes taken during class in the typical manner.

Dosage and Duration

Three studies provided complete information on the number, frequency, and length of intervention sessions. Two implemented the treatment weekly, but Cohen et al.'s study (2013) had 2-hour sessions for five weeks while Tsai and Wu (2010) had 14 sessions that included one 2-hour training and then recurring 15 min follow-ups. The third study providing complete information implemented the treatment for 30 min, twice a week, for eight total sessions over two months (Rahmani & Sadeghi, 2011). The other studies offered partial information, primarily identifying the number of sessions or weeks. This might have been as few as two weeks with an indeterminate number of sessions per week (Narjaikaew et al., 2009) to as many as 15 weeks with two sessions per week (Robinson et al., 2006).

Assessment of Note-Taking Quality

Although the descriptions provided by the study authors indicate that class factors other than the note-taking instruction (e.g., time, content) were held constant, we analyzed studies for their inclusion of measures assessing changes to students' note-taking quality in order to confirm that improvements in content learning could be attributable to improved note-taking skill. Two studies compared the note-taking quality of students in treatment and comparison groups. Rahmani and Sadeghi (2011) found that students using guided notes wrote significantly more words and key ideas and had more complete notes than students taking notes in their typical fashion. The latter had more discrepancies between main ideas and

supporting information, but neither group included many specific details. Spires (1992) holistically scored the format (split-page style, legibility, and abbreviations of recurring words) and content (accuracy of main points, accuracy of details, sequence, clarity) of students' notes and found that those using the split-page notes had significantly higher quality notes than students who did not receive instruction in how to take notes. Those who received the split-page plus self-questioning instruction had the highest quality notes among the three groups.

The other manner in which researchers assessed the impact of guided notes instruction on students' note taking was by examining their self-selected style. In the series of four studies conducted by Robinson et al. (2006), students were asked to take notes on a 500-word passage, even though the instruction they received was on the use of guided notes during lectures. In studies 1–3, a significantly greater proportion of students changed from a linear to a graphic style. In study 4, these results were similar at the midpoint preceding when students crossed conditions. After both groups had received the guided notes instruction, there were no differences in the proportion that changed to a graphic style of notes taken on a text.

Treatment Effects

We calculated a total of 28 effect sizes from data provided on group comparisons in the 10 studies (Table 5). The outcome measures varied based on the course in which the note-taking instruction was implemented but most often involved an objective test. Results are presented by note-taking type in the sections that follow.

Guided Notes

Eleven effect sizes were computed from data in the seven studies on guided notes. Participants in the single-case design study demonstrated strong treatment effects with no overlap of data in baseline and intervention (Lazarus, 1993). Even after accounting for increases in baseline scores on the psychology course quizzes, Tau-U effect sizes were all large (1.00) with the weighted average also 1.00 ($CI_{95} = 0.60$ to 1.40). The group design studies revealed small ($g = 0.41$; Robinson et al., 2007 [study 3]) to large ($g = 0.81$; Rahmani & Sadeghi, 2011) effect sizes computed from scores on tests, and the only negative effect of guided notes instruction ($g = -0.13$) was found for students in Robinson et al.'s (2007) study 4 who had to transition from receiving completed notes in the first three units of the course to filling in the guided notes in the last three units. All four of the Robinson et al. studies as well as the Narjaikaew et al. (2009) study measured students' learning with researcher-developed or -adapted tests of students' psychology ($g = -0.13$ to 0.58) or physics learning ($g = 0.65$), respectively. In only one guided notes study did the authors offer information on the technical adequacy of the outcome measure, an English reading comprehension test (Rahmani & Sadeghi, 2011). This is notable because it was also the study with stronger immediate ($g = 0.72$) and one-month delayed posttest effects ($g = 0.81$).

Split-Page Notes

The 16 effect sizes computed using data from two studies on split-page note outcomes were more variable. In comparing all students, moderate ($g = 0.54$) to strong ($g = 0.82$) effects were found for the researcher-developed, multiple-choice measures of English listening comprehension (Tsai & Wu, 2010). However, the disaggregated scores revealed a difference in magnitude between the

Table 5. Effect sizes.

Study and outcome measure[a]	95% CI LB	Effect size[b]	95% CI UB
Guided notes: Single-case design	**0.60**	**1.00**	**1.40**
Lazarus (1993): RD content quizzes Participant 1	0.37	1.00	1.63
Participant 2	0.44	1.00	1.57
Participant 3	0.47	1.00	1.53
Guided notes: Group designs			
Narjeikeaw et al. (2009): CSEM	0.51	0.65	0.78
Rhamani & Sadeghi (2011): TOEFL-RC immediate	0.25	0.72	1.19
Rhamani & Sadeghi (2011): TOEFL-RC delayed	0.34	0.81	1.29
Robinson et al. (2006), Study 1: RD content quizzes	0.08	0.45	0.82
Robinson et al. (2006), Study 2: RD content quizzes	0.21	0.58	0.94
Robinson et al. (2006), Study 3: RD content quizzes	0.03	0.41	0.79
Robinson et al. (2006), Study 4: RD content quizzes (T first)	0.04	0.56	1.09
Robinson et al. (2006), Study 4: RD content quizzes (T second)	−0.65	−0.13	0.38
Split-page: Group designs			
Spires (1992): RD immediate content quiz T1 v. C	−0.33	0.16	0.65
Spires (1992): RD immediate content quiz T2 v. C	1.50	2.11	2.73
Spires (1992): RD immediate content quiz T2 v. T1	1.47	2.05	2.63
Spires (1992): RD delayed content quiz T1 v. C	−0.33	0.15	0.64
Spires (1992): RD delayed content quiz T2 v. C	0.06	0.56	1.06
Spires (1992): RD delayed content quiz T2 v. T1	−0.05	0.42	0.90
Spires (1992): RD immediate content summary writing T1 v. C	−0.44	0.05	0.54
Spires (1992): RD immediate content summary writing T2 v. C	−0.40	0.09	0.58
Spires (1992): RD immediate content summary writing T2 v. T1	−0.42	0.05	0.52
Spires (1992): RD delayed content summary writing T1 v. C	−0.73	−0.24	0.25
Spires (1992): RD delayed content summary writing T2 v. C	−0.85	−0.35	0.14
Spires (1992): RD delayed content summary writing T2 v. T1	−0.59	−0.12	0.35
Tsai & Wu (2010): RD short conversations full sample	0.15	0.54	0.92
Tsai & Wu (2010): RD short conversations English notes	−0.18	0.36	0.90
Tsai & Wu (2010): RD short conversations Chinese notes	0.25	0.81	1.36
Tsai & Wu (2010): RD long lectures full sample	0.42	0.82	1.21
Self-restructured: Group design			
Cohen et al. (2013): RD exam items in T weeks v. C weeks	0.22	0.54	0.86
Weighted average effect size of all group designs	**0.47**	**0.54**	**0.62**

[a]Comparisons are T v. C, unless otherwise indicated.
[b]Effect sizes in the single-case design are Tau-U and in the group designs are Hedges's *g*.
Notes. C = comparison; CI = confidence interval; CSEM = conceptual survey of electricity and magnetism; LB = lower bound; RD = researcher-developed measure; T = treatment; T1 = split-page instruction; T2 = split-page and self-questioning instruction; TOEFL-RC = Test of English as a Foreign Language reading comprehension; UB = upper bound.

performance of those studying English as a foreign language who were assigned to take notes in their native Chinese ($g = 0.81$) as compared to those taking notes in English ($g = 0.36$).

The variability in treatment effects for the students in Spires' (1992) study was due, in part, to the inclusion of two treatment groups. There were no effects ($g = 0.15$ to 0.16) of the split-page instruction alone on students' immediate or three-week delayed test performance on a researcher-developed, multiple-choice test of listening comprehension when compared to controls. Nor were there effects on an immediate summary task graded holistically on a 5-point scale ($g = 0.05$), but there was a small, negative effect of the split-page treatment on the three-week delayed summary task ($g = -0.24$). It should be noted that students in this remedial learning strategies course were listening to videotaped sample lectures and not completing notes on content from disciplinary courses in which they were concurrently enrolled. Participants in the split-page plus self-questioning group demonstrated moderate to large effects on the multiple-choice, listening comprehension tests when compared to controls ($g = 2.11$ immediate and 0.56 delayed) and the split-page only group ($g = 2.05$ immediate and 0.42 delayed). However, there were no effects or small negative effects

on the summary tasks when compared to controls ($g = 0.09$ immediate and -0.35 delayed) and the split-page only group ($g = 0.05$ immediate and -0.12 delayed).

Self-Restructured Notes

The effect of teaching students to restructure their notes after a lecture was evaluated with a researcher-developed midterm exam of social psychology content (Cohen et al., 2013). Students served as their own controls, so their performance on items from treatment weeks was compared to that from control weeks and found to be moderate ($g = 0.54$).

All Note-Taking Types

When considering all 25 comparisons in the nine group design studies of note taking, the weighted mean effect size on content learning was moderate (0.54, $CI_{95} = 0.47$ to 0.62). Because all other group design studies compared note-taking instruction to no note-taking instruction, we also computed the weighted average effect after removing the four comparisons of the split-page treatments with and without self-questioning from the Spires (1992) study. The weighted average effect size of the remaining 21 treatment-control comparisons was about the same (0.52, $CI_{95} =$ 0.44 to 0.60). As shown in Figure 1, the forest plot of these effect sizes revealed an overall positive effect of note-taking instruction on content learning outcomes.

Study Quality

Studies were also synthesized by the rigor of their designs and methodology in order to inform our interpretation of the results. The criteria across the top of Table 6 were drawn from quality indicators of group design research (Raudenbush, 2005; What Works Clearinghouse [WWC], 2014). As can be seen, all studies in this corpus provided sufficient treatment and comparison data to compute effect sizes, and all but two studies (Cohen et al., 2013; Robinson et al., 2006 [study 4]) ensured separation of the conditions. Nine of the ten studies provided rich description of the treatments that allow for replication of the instructional components, but we noted earlier that the dosage and duration of that instruction were not consistently specified. In addition, none of the studies reported whether or how treatment integrity was monitored. Authors were more likely to account for the inter-rater reliability of scoring the outcome measures ($n = 5$ studies), but in no study were assessors reported as blind to participants' group assignments. Finally, two studies provided information on the technical adequacy of the outcome measures, but neither of these reported inter-rater reliability (Rahmani & Sadeghi, 2011; Tsai & Wu, 2010).

The criteria across the top of Table 7 were drawn from quality indicators of single case research designs (Kratochwill et al., 2013). Lazarus (1993) thoroughly described the intervention but not how the instructor's fidelity was monitored. There were at least three data points per phase (meeting standards with reservation) and an established inter-observer agreement for the scoring of probes. Although there were three replications of the treatment, there were less than three data points lag between moving participants 2 and 3 into intervention and both had increases in baseline.

Discussion

In contrast with previous reviews that have not distinguished note taking from note reviewing of provided notes or limited pretraining from planned instruction, this synthesis sought

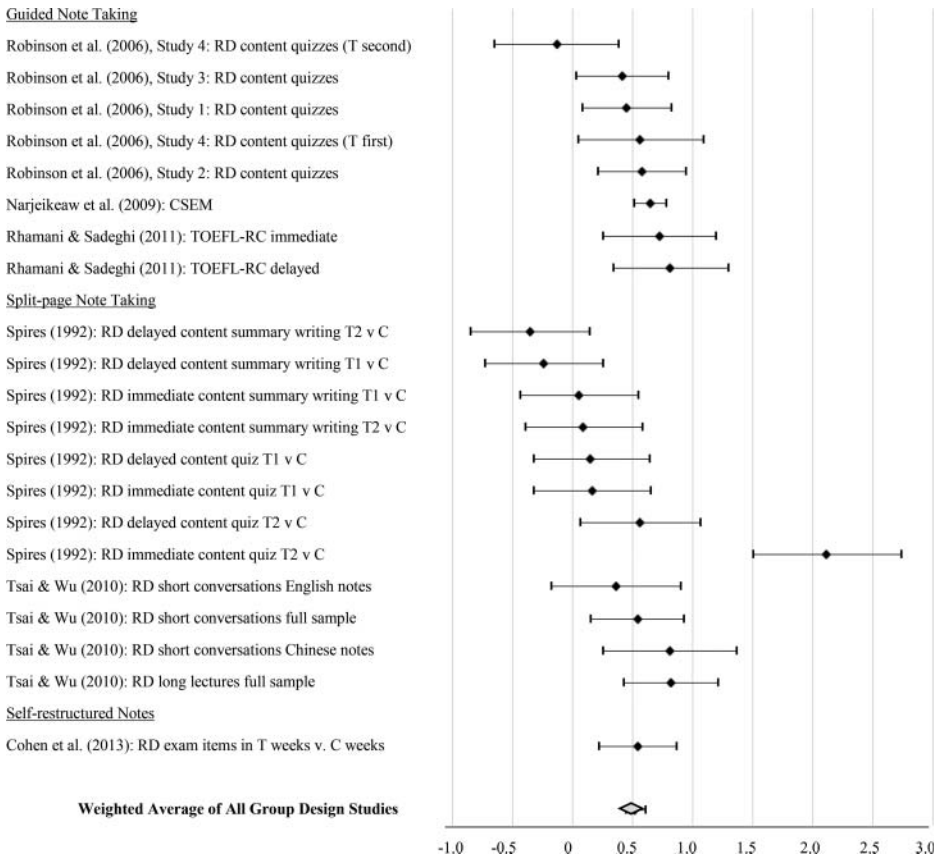

Figure 1. Forest plot of effect sizes. *Note* C = comparison; CSEM = conceptual survey of electricity and magnetism; MC = multiple choice test; RD = researcher-developed measure; T = treatment; T1 = split-page instruction; T2 = split-page and self-questioning instruction; TOEFL-RC = Test of English as a Foreign Language reading comprehension.

to determine the effects of extended note-taking instruction on the content learning of college students. All types of note taking had a mostly positive impact on student outcomes (weighted mean ES = 0.54), but the use of guided notes was associated with stronger and more consistent effects. The one negative effect ($g = -0.13$) found for students receiving guided notes during the last three units in the Robinson et al. (2006) study 4 should be interpreted in light of the research design. Prior to the crossover, the students had been receiving completed notes, which could have engendered a learned helplessness and a resistance to the increased challenge associated with filling in the blanks on the guided notes (Hansen & Stephens, 2000). That group of students also was being compared with students who had crossed over from a more active role in taking notes to receiving the completed versions, so the latter may have been more inoculated to the dependency associated with the transition.

Other than comparing treatment groups to comparison groups in which students received the completed notes, correct versions of notes were accessible during the intervention in only two studies—both of guided notes. The instructor in the Narjaikaew et al. (2009) study wrote information into a projected transparency of the worksheets or activity sheets so that students could copy or correct their own notes, and the three students in

Table 6. Quality indicators as reported in group design studies.

Study	Random assignment (Independent groups)	Instruction thoroughly described, replicable	Treatment integrity measured	Reliability & validity of outcome measures	Blind to condition	Inter-rater reliability measured	Means and *SD* for computing ES	ES based on treatment-comparison
Cohen et al. (2013)	–	–	–	–	–	–	+	+
Narjaikaew et al. (2009)	+	+	–	–	–	–	+	+
Rhamani & Sadeghi (2011)	+	+	–	+	–	–	+	+
Robinson et al. (2006), Study 1	+	+	–	–	–	+	+	+
Robinson et al. (2006), Study 2	+	+	–	–	–	+	+	+
Robinson et al. (2006), Study 3	+	+	–	–	–	+	+	+
Robinson et al. (2006), Study 4	–	+	–	–	–	+	+	+
Spires (1992)	+	+	–	–	–	+	+	+
Tsai & Wu (2010)	+	+	–	+	–	–	+	+

Notes. ES = effect size; + = Present; – = absent.

Lazarus's (1993) study used a corrected version to check how they completed their outlines. The researchers did not investigate differences in student performance when they were and were not exposed to correct versions of the guided notes, so whether this component might be fostering student passivity should be explored in future research.

Split-page notes were implemented in fewer studies ($n = 2$) as compared to guided notes ($n = 7$), and one study demonstrated several weak or negative effects (Spires, 1992). These results should be interpreted within the context in which the instruction was implemented. Unlike the other nine studies in the corpus, Spires was teaching the split-page format to students in a remedial learning strategies course with sample lectures not connected to the students' disciplinary coursework or a test grade. This removed setting may have reduced the relevancy of the instruction to participants because the same split-page approach was associated with moderate to strong effects ($g = 0.54$ to 0.82) in the Tsai and Wu (2010) study. Some believe remedial college courses are ineffective at preparing students for regular coursework or improving their success in college classes (e.g., Bailey, Jeong, & Cho, 2010; Bettinger & Long, 2009). It has been suggested that learning strategies be taught in tandem with regular courses instead of in isolation (Jenkins, Speroni, Belfield, Jaggars, & Edgecombe, 2010; Zeidenberg, Cho, & Jenkins, 2010). This kind of push-in model would be more similar to the implementation of the Lazarus (1993) study, the only other research including students with identified learning difficulties. There, the guided notes instruction was a supplement to the coursework.

Table 7. Quality indicators as reported in single case design study.

Study	Design	Stable baseline	Data	Lag	Treatment effect	IOA	Replicable	Fidelity of intervention
Lazarus (1993)	MB × P	–	+	–	+	+	+	–

Notes. + = Present; – = absent; Data = at least three data points per phase; IOA = inter-observer agreement in measuring dependent variable; Lag = at least three data points delay between replications; MB × P = multiple baseline across participants; Treatment effect = at least three replications.

Nevertheless, the split-page plus self-questioning instruction in the Spires (1992) study was associated with the strongest effects on immediate content learning ($g = 2.11$) of the 28 comparisons in the corpus as well as the highest magnitude of negative effects on delayed content summary writing ($g = -0.35$). With respect to the latter, it should be noted that the maximum score for a summary was 5, and the average performance of students in all three groups was below 2. The author concluded that a lack of instruction in summary writing or the use of inappropriate scoring criteria may have contributed to the results among this group of students identified for their literacy difficulties. In contrast, participants were taught explicitly to monitor their note taking and their understanding of the videotaped lectures through the use of self-questioning, which Spires believed contributed to the more robust effects of the treatment on immediate and delayed content learning as measured by researcher-developed multiple-choice quizzes. Moreover, there were moderate to strong effects on the quizzes from including the self-questioning as compared to teaching students how to take split-page notes without instruction in how to monitor their work ($g = 0.42$ to 2.05).

A focus on skills instruction alone, without a prescribed note-taking format, was only investigated in one study (Cohen et al., 2013). Although there was a moderate effect ($g = 0.54$), others have found that skills approaches require a high level of instructional investment with a low reward on student outcomes (Flippo & Caverly, 2000). Therefore, more research is needed to replicate Cohen et al.'s findings.

Across note-taking types, studies were more often conducted on notes taken during in-person classes rather than in flipped formats or from textbooks. Despite innovations in course delivery options (DesLauriers et al., 2011), only traditional classes were represented in the research. Nevertheless, the lectures in this corpus of studies included information projected to students, which necessitated applying note-taking skills flexibly to oral, written, and electronic content. This need to be facile was reinforced in the Robinson et al. (2006) studies, which taught note-taking during lectures but assessed students' skills on taking notes from text.

Implications of the Study Features

The findings have implications related to the samples and settings employed and the kind of note-taking instruction delivered. These features also suggest areas for future research.

Participants

From the information provided, it seemed more women than men were included in the studies. This may have contributed to the results because women have been found to record more information in greater detail than males (Cohn, Cohn, & Bradley, 1995), and the quality of students' notes have been the best predictor of student performance (Peverly & Sumowski, 2012). Hence, future studies should attempt to include more male participants or

document that the gender distribution is representative of that in the larger population from which the samples were drawn.

Eight of the ten studies occurred in undergraduate classes with 50 or more students enrolled, which is likely reflective of the kinds of courses in which note-taking skill would be important to student success (Hadley, 2007; Rachal et al., 2007). In three of those studies, participants were upperclassmen (Cohen et al., 2013) or demonstrated advanced knowledge of the subject (Rahmani & Sadeghi, 2011; Tsai & Wu, 2010), but otherwise students were likely considered novice learners. Williams and Eggert (2002) concluded from the note-taking literature that upper level students tended to have better skills, so it is possible that the stronger effects found in the three studies with more experienced students were related to their academic level or advanced knowledge. Moreover, the effects in the Tsai and Wu (2010) study were related to the language in which participants were taking notes. Split-page notes had a large impact on the listening comprehension performance of those recording information in their native Chinese ($g = 0.81$) but a moderate impact ($g = 0.54$) on those taking notes in English—even though they had completed more than eight years of English coursework. Note taking is a multifaceted skill for all learners (Bui & Myerson, 2014; Gur et al., 2013), so it stands to reason that the added complexity of working in a foreign language would further increase the challenge.

Instruction

In all 10 studies, the researchers were responsible for teaching the note-taking skills, and no treatment integrity or instructor training information was provided. Therefore, it is not possible to draw conclusions about the quality of the instruction delivered or the potential for these approaches to be successful when implemented by instructors who have less vested interest in the practice. Given that note-taking instruction routinely has not been provided to college students (Hadley, 2007; Rachal et al., 2007), the level of instructor responsibility required to prepare guided notes or to systematically teach note-taking skills in a postsecondary setting may make it difficult to achieve the consistency and intensity of implementation described for the studies in our corpus.

We purposefully located research with extended instruction in note taking because we believed students were not likely to improve on the basis of being told a couple of times to take notes a certain way. With the exception of one study that provided intervention during a 2-week unit (Narjaikaew et al., 2009), instruction in the other nine studies lasted for 5–16 weeks with sessions occurring 1–2 times per week. That would require a firm commitment from instructors, so future research might address how to prepare college lecturers for and support them in teaching note taking along with content. The journals in which the 10 studies we synthesized were published as well as the journals publishing other types of research on note taking reflect a widespread interest in the topic that is not isolated to one discipline. Hence, it seems to be an issue of enough importance in higher education to warrant an investment in time and resources.

Limitations

Despite the wealth of literature on note taking, we located a relatively small number of studies devoted to extended instruction at the postsecondary level, and 40% of them were from a series of related experiments published in one article (Robinson et al., 2006). Once disaggregated by note-

taking type, there were even fewer studies per group. Additional research would increase confidence in the findings, as would efforts to improve study rigor by monitoring implementation fidelity, blinding outcome raters to condition, and reporting inter-rater reliability. Although eight of the ten studies relied on researcher-developed or -adapted measures, which are known to be associated with higher effect sizes, we were interested in the use of note taking to support students' content learning in their college classes. This has customarily been measured by grades on the instructors' quizzes and exams. Future research might investigate whether note-taking instruction could impact student performance on certification, professional licensing, or graduate school entrance exams as distal outcomes; however, the proximal outcome of a course grade is of paramount concern to progression in higher education (Bailey et al., 2010).

Researchers also could improve confidence in their findings by reporting the technical adequacy, such as the internal consistency reliability, of their developed measures. Moreover, studies predicated on the notion that improving note taking is critical to postsecondary achievement might consider appropriate ways of assessing changes to students' note-taking quality. Only two studies in the corpus defined and measured quality of notes (Rahmani & Sadeghi, 2011; Spires, 1992). An additional four studies tracked pre- to post-intervention changes in students' note taking styles (moving from a linear to a graphic format) but did not evaluate the content of the notes (Robinson et al., 2006). Confirming changes in note-taking quality would strengthen the inference that extended instruction led to improved achievement.

Finally, it is important to note that nine of the ten studies used convenience samples, and either randomly assigned classes to treatment or employed a within-subjects (Cohen et al., 2013) or crossover design (Robinson et al., 2006 [study 4]). These are less rigorous than experimental designs with random assignment at the student level (WWC, 2014). Only Spires (1992) counterbalanced three instructors across treatments to control for an instructor effect, but the approach might be considered by other researchers who are restricted to using intact classes.

Conclusion

Between 1990 and August 2014, only 10 studies reported in seven articles addressed extended note-taking interventions for college students, even though it has been recognized as an important skill to academic success (Armbruster, 2009) and one with which students admittedly struggle (Rachal et al., 2007). The number of studies in our corpus can be contrasted with the 33 identified by Kobayashi (2006) when including note reviewing of provided notes and limited directions or pretraining. Clearly, more work has focused on providing students with completed versions of the instructor's notes. Expediency is not likely to lead to autonomy, even in flipped or technology-enhanced classes where students might have continual access to lecture content but are still accountable for learning from it (e.g., DesLauriers et al., 2011; Lage et al., 2000). Hence, the criticism of traditional face-to-face and lecture-based courses may be misplaced (e.g., Landrum, 2010; Murphy & Cross, 2002). The concern more rightly might be focused on whether students are taught the knowledge and skills necessary to actively engage in note taking either in preparation for or during class.

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