NOTETAKING IN COLLEGE CLASSES: STUDENT PATTERNS AND INSTRUCTIONAL STRATEGIES

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Historically, in-class notetaking has been a pervasive practice among college students. Palmatier and Bennett (1974) reported that 99% of college students take notes during instructors' lectures. Dunkel and Davy (1989) indicated that 94% of U. S. college students regard notetaking as pivotal to assimilating lecture content. Students attempt to record lecture content even when they are not explicitly instructed to do so. Some students try to record all the lecture information by using an individualized shorthand method; others pick and choose parts of a lecture that they deem important; and still others spend time doodling as they listen (Hartley & Marshall, 1974).

Given the pervasiveness and perceived importance of notetaking, this article attempts to integrate the research literature related to the patterns and effectiveness of notetaking in college classes. Virtually all of the studies reviewed in this article were done in the context of regular courses rather than in contrived laboratory situations. However, the studies usually related only to a small part of the targeted courses. The studies typically involved specific manipulations in which students took notes over a planned lecture and subsequently responded to a test over that lecture. Within the framework of the available research, the article addresses the logistics and results of both taking and reviewing notes. A variety of student variables, such as gender, academic level, and cognitive characteristics are also examined in relationship to notetaking. Most importantly, the article presents instructional strategies for maximizing the effectiveness of notetaking. Thus, the article should help instructors who teach courses with a strong content base to understand how notetaking could contribute to success in their courses and how they could promote effective notetaking.

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Notetaking Skills

Suritsky and Hughes (1991) proposed that notetaking involves four broad skills: listening, cognitive processing, recording lecture content in written form, and reviewing noted information. The first three skills usually occur contiguously. Listening and processing may occur virtually simultaneously, with notetaking typically following in a matter of seconds. Although reviewing of one's notes ideally should begin soon after the conclusion of each class session, it is often delayed until an examination is imminent.

Listening

Because they occur in such close succession, listening and processing are difficult to differentiate conceptually. Perhaps the difference between these concepts could be accentuated by equating listening with paying attention. Unless the student's attention is focused on what the instructor is saying at the moment, there is little chance that meaningful processing and notetaking will follow. Maintaining that attentional focus presents a considerable challenge for both instructor and students.

Unfortunately, notetaking research has given little consideration to moment-to-moment student attention in the college classroom. An informal analysis of listening patterns in selected classes at our university indicated that as few as 10% or as many as 98% of students could report what instructors had just said at given points in a lecture. Undoubtedly, the percentage of close listeners is affected by both student characteristics and presentation variables to be discussed later in this article.

Processing

Cognitive processing of lecture content involves at least two stages: (1) understanding each lecture point/idea and (2) connecting that understanding with one's existing knowledge (Suritsky & Hughes, 1991). Armbruster's (2000) synthesis of notetaking research subdivided the second stage into two processes: (a) integrating new points with previous points in the lecture (making internal con-

nections); (b) integrating new points with one's prior knowledge of the topic (making external connections). Collectively, the processing stages are often referred to as encoding in the notetaking research.

It is possible to hear what an instructor says, even repeat what the instructor said, with minimal understanding of the instructor's comment. Reframing a lecturer's comment/explanation in one's own words reflects a deeper level of processing than simply repeating the comment verbatim (Kiewra, 1985b). Students often want to record the instructor's exact words, but such notetaking may lead to rote memorization rather than comprehension of the targeted idea. A student may record an instructor's scholarly terminology without understanding what the instructor said. In contrast, restating an instructor comment in one's own word and then soliciting instructor verification of that interpretation sets the stage for more understandable notetaking.

Having comprehended an idea, the student's next processing challenge is to relate that notion to his or her existing knowledge in the subject area (Suritsky & Hughes, 1991). An isolated idea is likely to be less useful than one well-connected to an existing schema. Students may attempt to connect incoming information with existing knowledge in several ways. For example, as a student listens to a particular explanation, the student may think "that's an example of . . .," "that's the same as . . .," "that's different from . . .," "that's related to . . .," or "that goes under. . . ." Obviously, this attempt to connect current input with prior knowledge helps the student construct a conceptual schema of the day's discussion, while integrating that discussion into a larger conceptual framework for the course.

Notetaking

The first challenge in notetaking is to achieve a balance between listening, processing, and notetaking. Efficiency in notetaking would seem fundamental to achieving this balance. Efficiency of notes is technically defined in terms of the ratio between the number of conceptual points recorded and the number of words in the

notes. The literature is mixed on the efficacy of efficient notetaking. Howe (1970) reported that efficient notes were predictive of subsequent recall of a prose passage to which students listened, but other researchers (Fisher & Harris, 1973; Kiewra, 1984a) found efficient notes to be negatively related to achievement. At the very least, efficient notetaking appears to promote immediate recall of lecture information (Suritsky & Hughes, 1991).

In determining what to record, the student must distinguish between critical ideas and superfluous information. Students who do poorly on academic tasks often have difficulty judging the importance of lecture content, either failing to record the primary ideas or failing to highlight them when editing their notes (Armstrong, 1956; Hult, Cohn, & Potter, 1984; Kiewra & Fletcher, 1984). Unfortunately, distinctions between the essential and the expendable may not be readily evident as one initially listens to the elaboration of an idea.

Achieving an optimal mix between main ideas and specifics is one of the most complex features of notetaking. A principal value of specifics is that they can help the student reconstruct the main ideas at a later time (such as before an examination). Although recording more specifics may minimally affect immediate recall of lecture ideas, more details could be crucial in later revision of one's notes (Hartley & Marshall, 1974). Perhaps this is one reason why number of words recorded tends to be positively associated with performance measures (Kiewra & Fletcher, 1984; O'Donnell & Dansereau, 1993).

Despite the importance of recording both main ideas and supportive details, numerous studies (e.g., Baker & Lombardi, 1985; Hartley & Cameron, 1967; Hartley & Marshall, 1974; Kiewra, 1984a; Kiewra, 1985e; Kiewra, Benton, & Lewis, 1987; Kiewra, DuBois, Christian, & McShane, 1988; Locke, 1977; O'Donnell & Dansereau, 1993) found that college students fail to record many important lecture points. Across studies, the percentage of instructor ideas recorded by various types of students has ranged from a low of 11% (college freshmen) to 72% (college women). The more typical percentage of recorded notes is somewhere in the 30% to 40% range of lecture points.

The percentage of ideas recorded varies with the level of specificity of those ideas. Kiewra et al. (1987) categorized lecture points in four levels. Level-1 ideas were considered to be main points, whereas levels 2 through 4 ideas were increasingly subordinate points. Kiewra et al. found that students recorded 91% of the level-1 ideas, but decreasing percentages (60%, 35%, and 11%, respectively) of levels 2 through 4. This pattern suggests that most students record the general ideas but are less likely to record specifics related to those ideas.

Although specifics can be valuable in later recalling and reconstructing main ideas, attempting to record all the details could detract from one's understanding of the main idea(s). Notetakers can miss main points while recording minutia. Kiewra and Fletcher (1984) reported that notetakers emphasizing main points, rather than details, did better on both immediate and delayed test items over specifics, main ideas, and integration of ideas. In striking a balance between main ideas and specifics, the notetaker must weigh a specific in terms of its contribution to the main idea. If an example or detail captures the essence of a concept or defines the boundaries of that concept, that specific information is obviously worth recording.

In the final analysis, effective notes are characterized by clear organization (i.e., the relationship between main and subordinate ideas is clearly delineated). The most effective notes highlight an overall framework for a lecture and embellish that framework with critical specifics. A good test of organization is whether someone unfamiliar with a set of notes can easily follow the connection between the noted ideas. Sometimes even notetakers themselves have difficulty defining relationships between primary and secondary points as they later review their notes. On the other hand, time should not erode the clarity of well-organized notes.

Reviewing

Reviewing notes is the fourth major notetaking skill emphasized by Suritsky and Hughes (1991). However, because reviewing is a separate issue from taking notes, we will discuss reviewing after addressing the predictive potential of notetaking. Although review-

ing has its own predictive value, the literature contains much less information on the guidelines for reviewing than the guidelines for notetaking. Most of the research on reviewing focuses on the nature of the notes reviewed rather than the timing and logistics of the reviewing process (Armbruster, 2000).

Predictive Value of Notetaking

C.C. Crawford is considered a pioneering researcher on the effects of notetaking. In his 1925 study of the relationship between notetaking and quiz scores in college courses, students listened to lectures (from psychology and the general field of education) and recorded notes using their regular notetaking practices. Mastery of lecture information was primarily assessed via essay quizzes. Although Crawford obtained generally positive correlations between the number of ideas recorded in personal notes and the number included on a quiz, correlations between total points correct in both the notes and the quiz were consistently much stronger (with most being in the moderate range).

Recall of Noted Information

More recent studies (e.g., DiVesta & Gray, 1972; Einstein, Morris, & Smith, 1985; Fisher & Harris, 1973; Kiewra, 1984b) confirm Crawford's earlier finding that notetaking aids one's ability to recall noted information and do well on exams related to that information. For example, Einstein et al. (1985) found that subjects recalled 44% of ideas recorded in their notes but only 6% of ideas not in their notes. Although notetakers and non-notetakers did not differ in the amount of free recall of lecture content, notetakers did remember more important points. Kiewra (1984b) indicated that the number of lecture notes over a 4-week period correlated significantly both with performance on test items related to the lecture and performance on test items reflecting overall course content. Students were more than twice as likely to recall recorded than non-recorded points.

Although recorded points are more likely to be recalled than the non-recorded, recording selected points may actually aid recall of some non-recorded points. What is especially impressive about the Kiewra (1984b) results is that lecture notes predicted performance even on test items unrelated to the notes. In follow-up research, Kiewra and Benton (1988) again reported that notetaking (i.e., number of words, complex propositions, and main ideas) over a single lecture not only correlated significantly with test performance over that lecture but also with performance on a later course exam covering other lectures. However, not addressed in Kiewra and Benton's article is the nature of student notes over the additional lectures. Perhaps the students who took extensive notes over the target lecture also took extensive notes over the other lectures.

Specificity of Notes

The predictive potential of class notes is related to the specificity of those notes. For example, the records of main ideas in the Kiewra et al. (1987) study were not predictive of short-term or long-term test performance (most likely because 91% of the main points were recorded by the students). In contrast, the records of the intermediate-level points (levels 2 and 3) did have predictive value. In fact, correlations between noted subordinate ideas and test scores were higher when a more general course exam was given four weeks after the lecture than when a lecture-specific exam was given only one week after the lecture. The number of level-4 ideas (the most specific points) proved unrelated to performance on the lecture test, but was related to scores on the more general course examination. Again, it appears that the value of detailed notes increases with greater time between notetaking and performance assessment.

Taking vs. Reviewing Notes

In addressing the connection between notetaking and academic achievement, DiVesta and Gray (1973) concluded that both the

process and the product of notetaking affect academic achievement. This is not to say that the process and product functions are equally important, but simply that both affect performance. In fact, one of the leading notetaking researchers, Kenneth Kiewra, contends that while both notetaking and review contribute to performance, reviewing is the more powerful of the two contributors (Kiewra, 1985a, 1985b).

Importance of Notetaking

The process of taking notes, independent of reviewing the notes, presumably increases students' attention to a lecture and helps them encode ideas in an understandable fashion. The encoding process permits students to note subjective associations, inferences, and personal interpretations of the lecture material (DiVesta & Gray, 1972). However, notetaking does not ensure this level of processing. Perhaps a majority of students make little attempt to integrate concepts as they take notes (Kiewra, 1985a).

Kiewra (1985b) reviewed experimental research comparing the achievement of students who took notes with that of students who listened to lectures but took no notes. An analysis of 56 studies comparing notetaking and listening yielded the following pattern: 33 studies showed that students who took notes had greater achievement than those who only listened; 21 revealed no difference between taking notes and listening; and 2 showed that listening worked better than notetaking. These results appear to suggest that the process of taking notes more often than not contributes to performance based on lecture content.

Importance of Reviewing

One study reported in Kiewra's (1985b) review that did not support the process function of notetaking concluded that "simply recording notes is not an effective activity unless those notes are reviewed" (Kiewra, 1985a, p. 396). A meta-analysis (Henk & Stahl, 1985) on notetaking research supports Kiewra's (1985a) conclusion: simply taking notes negligibly affects recall of lecture information but reviewing one's notes substantially promotes recall.

One should not assume from this finding that all forms of review are superior to all forms of notetaking. Each can differ considerably in terms of effectiveness (Kiewra, 1983).

The product function of notetaking refers to having a hard copy of lecture ideas that can be reviewed subsequent to the lecture. Several studies, including Crawford (1925), Fisher and Harris (1973), Kiewra (1984b), Kiewra et al. (1987), and Locke (1977), all found significant correlations between the amount of notetaking and achievement when the students reviewed notes. Hartley (1983) and Kiewra (1985b) both reported that 75% of the experimental studies under review indicated that notetakers who review their notes perform better than notetakers who do not. Although students are more likely to recall noted than non-noted information, Palkovitz and Lore (1980) contend that having information in one's notes does not ensure correct responses to exam items related to that information. These researchers attributed this phenomenon to inadequate reviewing of one's notes.

Notetaking/Reviewing Combinations

In comparing a variety of notetaking and reviewing combinations, Fisher and Harris (1973) found that taking and reviewing one's own notes produced the greatest immediate recall of lecture content, while not taking notes and mentally reviewing the lecture content produced the least recall. The second best arrangement for promoting immediate recall was a combination of no notetaking with review of the lecturer's notes. In fact, the latter combination produced the same performance level on a test taken three weeks after the lecture as did taking and reviewing one's own notes.

Kiewra (1985c) reported that the advantages of reviewing notes are related to the accuracy, completeness, and organization of the notes. Kiewra found that students who reviewed a complete set of instructor notes did significantly better on factual items than did students who reviewed personal notes or reviewed mentally. In explaining his results, Kiewra pointed out that the "students who took and reviewed their own notes recorded only 35 critical lecture points and therefore had available only 30 percent of ideas that were in the instructor's notes" (p. 76). The notes provided by

the instructor were well organized, accurate, and contained 100% of the critical lecture points.

A notetaking condition that falls somewhere between personal notes and instructor notes is an arrangement labeled partial notes, in which instructors provide advance organizers for student notetaking. In combination with reviewing, the partial notes arrangement in one study (Annis, 1981) proved better than personal notes and instructor notes in promoting performance on multiple-choice examinations. However, personal notes best promoted performance on essay exams. This finding suggests that the efficacy of a particular notetaking/reviewing combination may differ across performance variables.

Irrespective of the notetaking procedure or the nature of notes, how one reviews the existing notes can make a difference in performance. Often students approach reviewing in a relatively passive way, simply reading through their notes and trying to remember lecture comments. King (1992) proposed a more active strategy for reviewing, using a procedure called self-questioning. Students are taught through direct instruction to ask higher-order comprehension questions about content in their notes. A combination of individual and group self-questioning of this nature has been particularly effective in promoting performance on delayed recall tests.

A corollary reviewing strategy, summarizing in writing the main and connected ideas in a lecture, produced better immediate recall of lecture ideas than did the self-questioning procedure (King, 1992). Hadwin, Kirby, and Woodhouse (1999) found that the number of idea units reflected in such summaries was an important predictor of lecture content recall. Not only does the thoroughness of the summaries appear to make a difference, the notetaking conditions under which students prepare the review summaries also affect their predictive potential. For example, Kiewra, Benton, Kim, Risch, and Christensen (1995) found that constructing a comparative essay about lecture points was primarily effective after student use of an outline framework for notetaking. Otherwise, students who prepared such essays performed less well on a later conceptual task than students who reviewed their notes in a conventional manner.

Impact on Factual and Higher-Order Responses

Reviewing strategies appear to differentially affect answers to factual questions more than answers to higher-order test questions. For example, Kiewra (1985a) found that students who reviewed personal notes scored significantly higher on factual items than students who took notes but reviewed without them. In contrast, reviewing notes made no difference on higher-order tasks involving inference, application, analysis, and synthesis. Kiewra and Benton (1987) reported that even the infusion of higher-order practice questions in the review of notes did not elevate student performance on higher-order test items. Thus, how one reviews notes after personal notetaking may affect recall of factual information but not necessarily higher-order reasoning with respect to that information.

The differential impact of reviewing on factual and higher-order test performance extends to instructor notes as well as personal notes. Kiewra (1985e) reported that listeners given instructor notes to review did better on the factual items of a test taken two days after the lecture than did students who took and reviewed their own notes. However, performance on the higher-order thinking items did not differ across the notetaking/reviewing combinations. Kiewra and Benton (1985) also found that students who simply listened to a lecture and then reviewed instructor notes did better on factual items than did students who recorded and reviewed personal notes. Again, performance on higher-order items was unrelated to the notetaking/reviewing conditions.

A compare-contrast essay over the content of a lecture may lend itself more to higher-order thinking more so than the tests typically used in notetaking research. Although this type of essay can be used as a reviewing mechanism, as in the Kiewra et al. (1995) study, it has also been used as a performance measure. For example, Benton, Kiewra, Whitfill, and Dennison (1993) found that students who prepared such essays with the aid of their own lecture notes wrote longer and more organized essays than did students who only listened to the lecture or who wrote without the use of their notes. This effect was magnified the longer the delay between the lecture and the writing task. Using notes as one con-

structs a conceptually based essay may offer greater opportunity to evidence higher-order reasoning than reviewing notes and then trying to answer specific questions about a lecture.

Relationship of Student Characteristics to Notetaking

Whatever the notetaking/reviewing conditions, certain types of students fare better with notetaking than do other types. Student characteristics that have been studied in relationship to notetaking include gender, academic level, and cognitive skills/orientation (e.g., working memory, field independence vs. field dependence, and learning disabilities).

Gender

Gender is among the student characteristics most frequently linked to the process and product functions of notetaking. Kiewra (1984a) found that female students noted more critical points, test-related points, and words than did male students. Also, females significantly outscored males on delayed exams over lecture material. One caution about generalizing from Kiewra's study is that his sample consisted of only 22 females and 7 males. In a more recent and larger study, Cohn, Cohn, and Bradley (1995) discovered that females recorded more words than males on a notetaking task, as well as also recording more detailed information about the subject matter. Eggert (2000) also found that females recorded more complete, extended, and accurate notes than did males. Plus, notetaking was more predictive of the principal performance measures in the course for females than for males.

These gender differences in notetaking patterns and effectiveness are paralleled by gender differences in perspectives of notetaking. Carrier, Williams, and Dalgaard (1988) examined the relationship between notetaking preferences and gender in a macroeconomics course. First, the Notetaking Perceptions Survey was used to determine students' notetaking preferences (Carrier & Newell, 1984). The results indicated that females valued notetaking more than males, had greater confidence in their notetaking skills,

and viewed themselves as more active notetakers (Carrier et al., 1988).

Academic Level

With a few exceptions (Eggert, 2000), cross-sectional research indicates that notetaking skills tend to increase across the college years. For example, Cohn et al. (1995) reported that upper-level college students were significantly better notetakers than lower-level students. Nye (1978) found that experienced male students recorded more notes than less experienced ones. Additionally, Carrier et al. (1988) indicated that advanced students had higher confidence levels in their notetaking than did less advanced. Studies by Hartley and Marshall (1974) and Hartley and Cameron (1967) respectively reported that college freshman noted less than half as many critical lecture points as third year students.

A possible contributor to academic-level differences in notetaking is that only 17% of college students report receiving formal instruction on how to take notes (Palmatier & Bennett, 1974). Because most students apparently must develop notetaking skills on their own, one would expect those skills to improve with time and experience.

Cognitive Skills/Orientation

Students also may differ in the cognitive skills required for notetaking. Information processing is one cognitive construct that has been linked to notetaking skills. Kiewra et al. (1987) found that an information processing test that presumably assessed the ability to cognitively hold and manipulate sentence-level information was correlated with most levels of notetaking. In contrast, ACT Verbal scores were unrelated to notetaking variables. Kiewra and Benton (1988) also reported that several notetaking variables (number of words, complex propositions, and main ideas) were much more strongly related to information-processing ability than to a variety of conventional academic predictors (GPA, ACT Composite, and ACT Verbal). In a similar vein, Worth (2000) found notetaking to be unrelated to critical thinking measures in a large

human development course, even though both variables were highly predictive of exam performance. Thus, although information-processing variables may relate to effective notetaking, more conventional measures of cognitive skills or mastery appear minimally linked to notetaking proficiency. A more likely possibility is that cognitive skills affect one's understanding and retention of information in a given set of notes.

Kiewra and Benton (1988) concluded that "the effective notetaker uses working memory capacity to attend, store, and manipulate information selected from the lecture simultaneously, while also transcribing ideas just previously presented and processed" (p. 35). Although notetaking apparently facilitates learning in students with a greater working-memory capacity (Kiewra, 1989), it may be detrimental to learning for notetakers with more limited working memory (Berliner, 1969, 1971; DiVesta & Gray, 1973). The latter kind of student may fare better by simply listening to the lecture presentation than trying both to listen and take notes. However, under some conditions, students with high working memory also perform better by simply listening than by combining notetaking with listening (Hadwin et al., 1999). If such students are provided an instructor's set of notes on a difficult lecture, listening to the lecture appears more effective than attempting to take notes while listening.

Another cognitive variable related to the effectiveness of notetaking is field independence versus field dependence. Field-dependent perception is restricted to the inherent structure of what one sees and hears, whereas field-independent perception often entails restructuring what one sees and hears. Frank (1984) reported that field-independent and field-dependent students record a similar number of lecture ideas, but that field-independent students take more outlined and efficient notes than do field-dependent students. Students who are field dependent, like those who have limited working memory, often achieve less when they record notes than when they simply listen to the lecture. In general, field-independent students do better on both factual and higher-order tests than do field-dependent students, irrespective of the notetaking approach (Kiewra & Frank, 1988). However, when given an adequate set of notes to review and sufficient time to

review those notes, field-dependent students tend to do as well as field-independent.

An additional cognitive construct that has received some attention in the notetaking research is learning disability. For example, Hughes and Suritsky (1993) compared the lecture notes of students identified as having learning disabilities with notes of students not identified as having learning disabilities. The most dramatic difference was in the amount of lecture information recorded, with the students not identified as having a learning disability recording 60% to 70% more information. This quantitative difference may have been due in part to the use of abbreviations, which may allow students to cover a wider range of information than would the use of only intact words. The notetaking difficulties of students with learning disabilities are also linked to slow writing, attentional divergence, indecision about what to record, and ambiguity in their notes (Suritsky, 1992).

Strategies for Improving the Efficacy of Notetaking

Though considerable research documents the efficacy of notetaking for most students, research also indicates that notetaking can impede learning for certain types of students under some circumstances. For example, the act of writing notes may interfere with the assimilation of information being presented, especially for students with limited working-memory capacity. Critical information may be missed or misinterpreted while students record previously mentioned points (DiVesta & Gray, 1973; Peters, 1972). Thus, the challenge is to identify instructional/notetaking combinations that can make learning easier for students who have difficulty with conventional notetaking.

Oral Presentation Variables

The impact of notetaking on learning may be affected by a number of presentation variables. Aiken, Thomas, and Shennum (1975) compared students' recall under (a) two instructor speaking rates (normal and speeded), (b) two information-density rates (low and

high), and (c) three notetaking conditions (parallel, spaced, and no notetaking). In parallel notetaking students were told to take notes as they listened to the lecture; in spaced notetaking they were instructed to listen attentively to lecture and take notes during deliberate pauses in the lecture; and in no notetaking they were told to listen attentively and not record notes. Recall was assessed 48 hours after the lecture presentation.

The findings from the Aiken et al. (1975) study indicated that students had greater recall when notetaking was temporally separated from listening to the lecture (spaced notetaking). Students can use pauses in the lecture not only to record what they have just heard but also to clarify what the instructor said by consulting either the instructor or other students. Ruhl and Suritsky (1995) reported that the pausing procedure was especially effective in helping students with learning disabilities to take more complete notes and immediately recall information in their notes. The opportunity for these students to discuss lecture points with students not having learning disabilities produced a greater volume of partly recorded ideas than using the pauses strictly for reflection and notetaking (Ruhl, 1996).

Recall in the Aiken et al. (1975) study was also affected by speaking rate and information density. Recall was better under a normal speaking rate and low-density condition than under a speeded rate and high-density condition. However, the differential impact of speaking rate on recall was greater for low-density than high-density material. A speaking rate that proved as good or better than normal speaking under both parallel and spaced notetaking was a twice-through speeded rate (i.e., repeating each lecture segment at a speeded rate).

Although the role of class discussion within a predominantly lecture format has not been well researched, interspersed interaction between instructor and students (as well as between students and students) may serve several functions including clarifying points made by the instructor, heightening attention to what is being discussed, and providing time to record the gist of the instructor's point. Asking students to articulate their understanding of an idea just presented by the lecturer would be a good starting point for this interaction. Also especially promising for class dis-

cussion are interspersed higher-order questions built directly on the information being presented, thus serving as a check for how deeply lecture information is being processed. Plus, inquiry-based discussion has shown some promise for promoting critical thinking skills at the college level (Terenzini, Springer, Pascarella, & Nora, 1995; Tsui, 1998).

Visual Aids

Visual stimuli enhance notetaking by attaching visual cues to the spoken word. Although most students fail to record a substantial amount of lecture information, most record all the information included in transparencies (Boswell, 1980). Baker and Lombardi (1985) indicated that students generally recorded all the information on transparencies but only 27% of the additional relevant information. Similarly, Suritsky and Hughes (1991) found that writing information on a chalkboard substantially increased the likelihood of its being noted and recalled. Locke (1977) reported that students failed to record nearly half of the material not written on the board but missed only 12% of the material on the board. Visual cues likely would be increasingly important in sustaining notetaking during extended lectures, given the finding that students tend to record fewer points in the last half of a lecture than in the first half (Locke, 1977).

Visual cues in the form of transparencies and information on the board are likely to have an equalizing effect on student notes and performance. For example, the least successful students in Boswell's (1980) research benefited the most from transparencies. Percentage of points recorded from material written on the board did not differentiate performance levels in Locke's (1977) study, but student proficiency in recording information *not* written on the board was significantly predictive of course grade. For example, students who had "A" grades recorded an average of 62% of the conceptual points *not* written on the board, compared to decreasing percentages for students making lower grades in the course.

Despite the benefits of transparencies and material on the board, using class time for students to record this information may

not be the best use of that time. Providing handouts of this information would be more efficient. For example, in one of our large undergraduate courses, most transparencies are provided at the course web site. Students are expected to print these transparencies and have them available in class when they are discussed. Among the types of information that could be presented efficiently via handouts are definitions of key terms, major research findings on a particular topic, detailed tables and figures, and references for information presented in class (Hartley & Cameron, 1967).

Notetaking Framework

Possibly the greatest aid to notetaking is an instructor-developed framework of superordinate and subordinate points in a lecture, with space available for student notes within the schema. (This arrangement was identified earlier in this article as partial notetaking.) The two types of instructor-developed frameworks that have been most researched are linear/skeletal outlines and matrices (Kiewra, DuBois, Christensen, Kim, & Lindberg, 1989; Kiewra, DuBois, et al., 1991; Kiewra, Mayer, Christensen, Kim, & Risch, 1991). The former links main and secondary points in outline form, with space provided for students to add notes within the outline. The matrix framework uses "the main topics as the column headings and the subtopics as row headings, with space in the matrix cells for taking notes" (Armbruster, 2000, p.185).

A principal benefit of the outline format is that it highlights superordinate-subordinate relationships within topics, whereas matrices promote mapping of relationships both within and across topics. Armbruster (2000) concluded in her review of notetaking research that both outlines and matrices likely "serve as advance organizers, focus student attention, provide guides for notetaking, and give retrieval cues" (p. 194). Presumably, both frameworks help students make internal connections among ideas in a lecture, resulting in better organized schemata. Both also produce more notetaking ideas than does conventional notetaking (Kiewra et al., 1989; Kiewra, DuBois et al., 1991). In addition, reviewing outline and matrix notes has resulted in better recall than reviewing verbatim instructor notes (Kiewra et al., 1988).

Each of the partial frameworks has some potential advantages over the other. For example, Kiewra et al. (1989) found that outlined notes contained more lecture ideas than did matrix notes. Similarly, Kiewra et al. (1995) reported that outlined notetaking promoted more internal connections in lecture ideas than did matrices. The outline format not only produced more notes than did matrix and conventional notetaking but also better performance on recall and relational tasks that required students to identify concepts/approaches that share target characteristics. On the other hand, Kiewar, DuBois, el al. (1991) found that matrix notetaking led to higher performance on a cued recall test over lecture content than did outlined notetaking, but this superiority did not extend to the synthesis of lecture concepts.

Student preferences for notetaking formats sometimes moderate the effectiveness of these formats. For example, Collingwood and Hughes (1978) obtained an interaction between notetaking preferences and notetaking conditions. On a multiple-choice test one month after experimental lectures, students who preferred their own notes or partial notes performed best after experiencing a partial notes condition. Conversely, those who preferred instructor notes did best after reviewing instructor notes. Collingwood and Hughes also found that student preferences changed in favor of instructor notes after exposure to all three notetaking arrangements.

In contrast to the Collingwood and Hughes (1978) findings, Annis (1981) reported that student preferences did not moderate the effectiveness of notetaking formats. Students who had experienced either personal notetaking, partial notetaking, or no notetaking combined with instructor notes preferred the partial notes condition both before and after experience with the three notetaking arrangements. Nonetheless, the effectiveness of the three conditions was not affected by student preferences (i.e., students did not necessarily do best with their preferred approach).

Some notetaking researchers (e.g., Annis & Davis, 1975; Kiewra, 1985d) contend that following partial notetaking with a complete set of instructor notes would be the most powerful notetaking/reviewing arrangement for most students. Notes provided by the instructor typically are more complete and accurate

than notes taken by students under any notetaking arrangement. Thus, instructor notes can add specificity and refinement to student notes. Full instructor notes should be increasingly beneficial the longer the delay between the lecture and the reviewing or testing situation. If students had to choose between reviewing their own notes or the instructor's notes, the latter might be a better choice for the long-term. However, the combination of the two is likely superior to either alone (Kiewra, 1985d).

Under the combination alluded to above, students would receive the instructor's framework for notetaking prior to their taking notes and then receive the instructor's detailed notes after they had taken notes. To optimize this combination, instructors might allow access to their notes only after students presented their partial notes for inspection (i.e., students would earn access to the instructor's notes). Otherwise, many students might forego notetaking—thus losing potential encoding benefits—and simply wait for the instructor's notes. Morgan, Lilley, and Boreham (1988) reported that the more information in instructor handouts, the fewer notes students will record. Perhaps as critical as the information density of instructor handouts, however, are the contingencies governing their accessibility.

We have used a modified version of the partial notes/instructor notes combination. The students take their notes in a study guide having questions about the readings and lecture content. Students answer the lecture questions during class discussion. Following each day's discussion, the instructor posts additional information regarding the discussion at the course web site. The posted information may elaborate on difficult issues in the lecture and provide more specifics on other issues. The posted notes are intended to compliment rather than replace class notes. The posted notes do not repeat verbatim what has been discussed in class. They are written in such a way as to be optimally beneficial to students who have already taken notes in class.

Videotape of Class Presentation

Another after-the-fact aid for students who have difficulty combining listening and notetaking is providing a videotape of the

lecture for individual student viewing. With their class notes in hand, students can pause the tape whenever they wish to note an idea or back up the tape to hear a repeat explanation of an idea. Potentially, this strategy would work better than the instructor's controlling the pausing or speaking rate in a live lecture.

Kiewra, Mayer, Christian, Dyreson, and McShane (1988) had students watch a videotaped lecture one, two, or three times, with instructions to record different notes each viewing. The students recorded significantly more lecture ideas in multiple viewings than in a single viewing. The recording difference mainly related to the ideas of middle-level importance. Subsequent research (Kiewra, Mayer, et al., 1991) confirmed that students record the most important notes in the first viewing and add increasingly secondary points in subsequent viewing. Kiewra et al. (1997) recently reported that repeated viewing of a taped lecture not only increased notetaking, but also increased recognition of isolated facts and overall recall.

Although we have just begun to experiment with student viewing of videotaped lectures, informal evidence suggests that students find these tapes a valuable aid when they have missed class or have been unable to keep pace with the live lectures. Although Kiewra (1987) contends that viewing a videotaped lecture is not as effective as viewing a live lecture, using a videotape as an aid to upgrade one's class notes allows the student complete control over pauses and repetition in the presentation. We have found student use of videotapes to be influenced largely by convenience. For example, students are more likely to use the tapes if they have their own copies (which they can view any time anywhere) than if they have to go to an instructional lab during specified hours to view the tapes.

Concluding Observations

Notetaking is among the most powerful contributors to performance in courses having a strong content base. Worth (2000) found that notetaking variables were more predictive of overall course performance than were either class attendance or critical thinking

skills. Of the class-note variables addressed in his research, Eggert (2000) found that accuracy of class notes better predicted performance than did either completeness of notes (number of points noted in a structured framework for notetaking) or quantity of notes (number of words in notes). Eggert's finding is a throw back to a finding reported by Crawford (1925) that total points *correct* in notes is a better predictor of performance than is the number of points per se.

One limitation of the notetaking research literature is that much of it deals with the short-term effects of notetaking over controlled lectures. Also, the primary variables used to assess the effects of notetaking have been test scores, often derived from multiple-choice exams. Although this research is laudable with respect to control of variables, the extent to which the findings reflect the nature and impact of notetaking in full-semester courses needs additional study. Specifically, more research is needed on notetaking in courses that use discussion formats, involve out-of-class notetaking, and encompass outcome measures other than test scores.

Our own research is now addressing some of the gaps in the notetaking literature. For example, Eggert (2000) examined the nature and effects of both in-class and out-of-class notetaking on a variety of outcome measures in a large, full-semester course employing a partial-discussion format (i.e., instructors interspersed discussion questions in the class presentations). At the conclusion of the semester, Eggert analyzed student notes over both in-class discussion and out-of-class reading materials for completeness, quantity, and accuracy. Notes from the reading material better predicted performance on essay tests over the readings, but class discussion notes better predicted scores on a course project and multiple-choice tests. In a follow-up analysis, Williams and Eggert (in press) found that notetaking over class discussion, compared to notetaking over reading materials, better predicted performance on multiple-choice exam items based strictly on the readings as well as items based exclusively on class discussion.

Although instructor-developed frameworks for notetaking have been well defined, the logistics for sharing instructor notes with students need further delineation. For example, is it better to share

instructor notes *only* after students have done their own notetaking, or is it better to share selected instructor notes prior to class discussion? Both strategies can complement what is discussed in class, but the intent of the two approaches can be somewhat different. Instructor notes shared after class discussion provide a means for students to check the completeness and accuracy of their own notes. Note shared before class are intended to give students a head start on in-class notetaking and better prepare them for participation in class discussion. We have tried both approaches by posting class notes at the course web site, but the relative impact of the two approaches is still under investigation. The most obvious instructor benefit of sharing one's notes with students, either before or after class, is that one need not feel compelled to cover everything in class, thus freeing more time to discuss the implications of course content.

A variety of personal variables are related to notetaking skills. Females tend to be better notetakers over lecture material than are males. Notetaking also better predicts major performance measures for females than males. Although college students, on average, record less than 50% of the critical points in a lecture, the percentage of critical points noted increases as students advance academically. Students who have a considerable capacity for holding ideas in working memory and who are field-independent tend to do better in notetaking than students having opposite characteristics. However, generic measures of cognitive skills (e.g., critical thinking, ACT, and SAT) appear minimally related to proficiency in notetaking. This finding does not preclude the possibility that cognitive skills may affect one's understanding and remembrance of noted information.

Finally, instructors wishing to promote effective notetaking in their courses should consider the following possibilities: (a) constructing a partial framework for student notetaking, (b) giving students hard copies of transparencies and other visual information that otherwise would take excessive class time to record, (c) inserting brief pauses during lectures for students to record critical information being presented, (d) sharing their lecture notes with students, and (e) videotaping their lectures for students to view outside of class in order to check and refine their notes. Al-

though most students can benefit from these provisions, notetakers likely to benefit the most are field-dependent students with limited working memory capacity.

References

Aiken, E. G., Thomas, G. S., & Shennum, W. A. (1975). Memory for a lecture: Effects of notes, lecture rate, and informational density. *Journal of Educational Psychology, 67,* 439-444.

Annis, L. F. (1981). Effect of preference for assigned lecture notes on student achievement. *Journal of Educational Research, 74,* 179-182.

Annis, L., & Davis, J. K. (1975). The effect of encoding and external memory device on note-taking. *Journal of Experimental Education, 44*, 44-46.

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

Armstrong, W. H. (1956). *Study is hard work.* New York: Harper and Brothers.

Baker, L., & Lombardi, B. R. (1985). Students' lecture notes and their relations to test performance. *Teaching of Psychology, 12,* 28-32.

Benton, S. L., Kiewra, K. A., Whitfill, J. M., & Dennison, R. (1993). Encoding and external-storage effects on writing processes. *Journal of Educational Psychology, 85,* 267-280.

Berliner, D. C. (1969). *Effects of test-like events and notetaking on learning from lecture instruction.* Paper presented at the meeting of the American Psychological Association, Washington, D. C.

Berliner, D. C. (1971). *Aptitude-treatment interactions in two studies of learning from lecture instruction.* Paper presented at the meeting of the American Educational Research Association, New York.

Boswell, D. A. (1980). Evaluation of transparencies for psychology instruction. *Teaching of Psychology, 7,* 171-173.

Carrier, C. A., & Newell, K. (1984). What dental hygiene students think about notetaking: Report of a survey. *Canadian Dental Hygienist, 18,* 13-17.

Carrier, C. A., Williams, M. D., & Dalgaard, B. R. (1988). College students' perceptions of notetaking and their relationship to selected learner characteristics and course achievement. *Research in Higher Education, 28,* 223-239.

Cohn, E., Cohn, S., & Bradley, J., Jr. (1995). Notetaking, working memory, and learning in principles of economics. *The Journal of Economic Education, 26,* 293-307.

Collingwood, V., & Hughes, D. C. (1978). Effects of three types of university lecture notes on student achievement. *Journal of Educational Psychology, 70,* 175-178.

Crawford, C. C. (1925). The correlation between lecture notes and quiz papers. *Journal of Educational Psychology, 12,* 379-386.

DiVesta, F. J., & Gray, G. S. (1972). Listening and note taking. *Journal of Educational Psychology, 63,* 8-14.

DiVesta, F. J., & Gray, G. S. (1973). Listening and notetaking II. *Journal of Educational Psychology, 64,* 278-287.

Dunkel, P., & Davy, S. (1989). The heuristic of lecture notetaking: Perceptions of American & international students regarding the value & practice of notetaking. *English for Specific Purposes, 8,* 33-50.

Eggert, A. C. (2000). *An investigation of notetaking as a predictor of course performance and course.* Unpublished doctoral dissertation, The University of Tennessee.

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

Fisher, J. L., & Harris, M. B. (1973). Effects of note taking and review on recall. *Journal of Educational Psychology, 65,* 321-325.

Frank, B. M. (1984). Effect of field independence-dependence and study technique on learning from a lecture. *American Educational Research Journal, 21,* 669-678.

Hadwin, A. F., Kirby, J. R., & Woodhouse, R. A. (1999). Individual differences in notetaking, summarization, and learning from lectures. *The Alberta Journal of Educational Research, 45*(1), 1-17.

Hartley, J. (1983). Notetaking research: Resetting the scoreboard. *Bulletin of the British Psychological Society, 36,* 13-14.

Hartley, J., & Cameron, A. (1967). Some observations on the efficiency of lecturing. *Educational Review, 20,* 30-37.

Hartley, J., & Marshall, S. (1974). On notes and note-taking. *Universities Quarterly, 28,* 225-235.

Henk, W. A., & Stahl, N. A. (1985, November). *A meta-analysis of the effect of notetaking on learning from lecture.* Paper presented at the annual meeting of the National Reading Conference, St. Petersburg Beach, FL.

Howe, M. J. A. (1970). Using students' notes to examine the role of the individual learner in acquiring meaningful subject matter. *Journal of Educational Research, 64,* 61-63.

Hughes, C. A., & Suritsky, S. K. (1993). Notetaking skills and strategies for students with learning disabilities. *Preventing School Failure, 38,* 7-11.

Hult, R. E., Cohn, S., & Potter, D. (1984). An analysis of student notetaking effectiveness and learning outcome in college lecture setting. *Journal of Instructional Psychology, 11,* 175-181.

Kiewra, K. A. (1983). The process of review: A level of processing approach. *Contemporary Educational Psychology, 8,* 366-374.

Kiewra, K. A. (1984a). Implications for notetaking based on relationships between notetaking variables and achievement measures. *Reading Improvement, 21,* 145-149.

Kiewra, K. A. (1984b). The relationship between notetaking over an extended period and actual course-related achievement. *College Student Journal, 17,* 381-385.

Kiewra, K. A. (1985a). Examination of the encoding and external-storage functions of notetaking for factual and higher-order performance. *College Student Journal, 19,* 394-397.

Kiewra, K. A. (1985b). Investigating notetaking and review: A depth of processing alternative. *Educational Psychologist, 20,* 23-32.

Kiewra, K. A. (1985c). Learning from a lecture: An investigation of notetaking, review and attendance at a lecture. *Human Learning, 4,* 73-77.

Kiewra, K. A. (1985d). Providing the instructor's notes: An effective addition to student notetaking. *Educational Psychologist, 20*(1), 33-39.

Kiewra, K. A. (1985e). Students' notetaking behaviors and the efficacy of providing the instructor's notes for review. *Contemporary Educational Psychology, 10,* 378-386.

Kiewra, K. A. (1987). Notetaking and review: The research and its implications. *Instructional Science, 16,* 233-249.

Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review, 1,* 147-172.

Kiewra, K. A., & Benton, S. L. (1985). The effects of higher-order review questions with feedback on achievement among learners who take notes or receive instructor's notes. *Human Learning, 4,* 225-231.

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., & Lewis, L. B. (1987). Qualitative aspects of notetaking and their relationship with information-processing ability and academic achievement. *Journal of Instructional Psychology, 14,* 186-194.

Kiewra, K. A., Benton, S. L., Kim, S-I., 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., DuBois, N. F., Christian, D., & McShane, A. (1988). Providing study notes: Comparison of three types of notes for review. *Journal of Educational Psychology, 80,* 595-597.

Kiewra, K. A., DuBois, N. F., Christensen, M., Kim, S-I, & Lindberg, N. (1989). A more equitable account of the note-taking functions in learning from lecture and from text. *Instructional Sciences, 18,* 217-232.

Kiewra, K. A., DuBois, N. F., Christian, D., McShane, A., Meyerhoffer, M., & Roskelley, D. (1991). Note-taking functions and techniques. *Journal of Educational Psychology, 83,* 240-245.

Kiewra, K. A., & Fletcher, H. J. (1984). The relationship between levels of notetaking and achievement. *Human Learning, 3,* 273-280.

Kiewra, K. A., & Frank, B. M. (1988). Encoding and external-storage effects of personal lecture notes, skeletal notes, and detailed notes for field-independent and field-dependent learners. *Journal of Educational Research, 81,* 143-148.

Kiewra, K. A., Mayer, R. E., Christian, D., Dyreson, M., & McShane, A. (1988, April). *Quantitative and qualitative effects of repetition and note-taking on learning from videotaped instruction.* Paper presented at the annual meeting of the American Educational Research Association, New Orlearns, LA.

Kiewra, K. A., Mayer, R. E., Christensen, M., Kim, S-I., & Risch, N. (1991). Effects of repetition on recall and notetaking: Strategies for learning from lectures. *Journal of Educational Psychology, 83,* 120-123.

Kiewra, K. A., Mayer, R. E., DuBois, N. F., Christensen, M., Kim, S-I., & Risch, N. (1997). Effect of advance organizers and repeated presentations on students' learning. *The Journal of Experimental Education, 65,* 147-159.

King, A. (1992). Comparison of self-questioning, summarizing, and notetaking-review as strategies for learning from lectures. *American Educational Research Journal, 29,* 303-323.

Locke, E. A. (1977). An empirical study of lecture notetaking among college students. *Journal of Educational Research, 77,* 93-99.

Morgan, C. H., Lilley, J. D., & Boreham, N. C. (1988). Learning from lectures: The effect of varying the detail in lecture handouts on note-taking and recall. *Applied Cognitive Psychology, 2,* 115-122.

Nye, P. A. (1978). Student variables in relation to note taking during a lecture. *Programmed Learning and Educational Technology, 18,* 16-22.

O'Donnell, A., & Dansereau, D. F. (1993). Learning from lectures: Effects of cooperative review. *Journal of Experimental Education, 61,* 116-125.

Palkovitz, R. J., & Lore, R. K. (1980). Note taking and note review: Why students fail questions based on lecture material. *Teaching of Psychology, 71,* 465-470.

Palmatier, R. A., & Bennett, J. M. (1974). Notetaking habits of college students. *Journal of Reading, 18,* 215-218.

Peters, D. L. (1972). Effects of note taking and rate of presentation on short-term objective test performance. *Journal of Educational Psychology, 63,* 276-280.

Ruhl, K. L. (1996). Does nature of student activity during lecture pauses affect notes and immediate recall of college students with learning disabilities? *Journal of Postsecondary Education and Disability, 12* (2), 16-27.

Ruhl, K. L., & Suritsky, S. (1995). The pause procedure and/or an outline: Effect on immediate free recall and lecture notes taken by college students with learning disabilities. *Learning Disability Quarterly, 18* (1), 2-11.

Suritsky, S. K. (1992). Notetaking difficulties and approaches reported by university students with learning disabilities. *Journal of Postsecondary Education and Disability, 10* (1), 3-10.

Suritsky, S. K., & Hughes, C. A. (1991). Benefits of notetaking: Implications for secondary and postsecondary students with learning disabilities. *Learning Disability Quarterly, 14* (4), 7-18.

Terenzini, P. T., Springer, L., Pascarella, E. T., & Nora, A. (1995). Influences affecting the development of students' critical thinking skills. *Research in Higher Education, 36,* 23-29.

Tsui, L. (1998). *A review of research on critical thinking.* Paper presented at the annual meeting of the Association for the Study of Higher Education, Miami, FL.

Williams, R. L., and Eggert, A. C. (in press). Notetaking predictors of test performance. *Teaching of Psychology.*

Worth, S. L. (2000). *Critical thinking ability as a predictor of success in a large undergraduate course.* Unpublished doctoral dissertation, The University of Tennessee, Knoxville.