Notetaking Strategies for University Bound Learners

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ABSTRACT

Although there has been considerable research interest in examining the relative advantages of either writing notes or reviewing them in learning from a lecture, there is an absence of studies investigating the benefits of notetaking and review strategies in concert. The purpose of the present study is to determine whether teaching students to write Matrix notes and to review them by writing Examples benefits students’ recording and recall of lecture ideas.

Four notetaking strategies were examined in the study: Example-Matrix, Example Only, Matrix Only, and Conventional. Across these groups, four questions were explored: (a) whether the Example-Matrix strategy enhanced students’ encoding as measured by a cued-recall test containing the headings that were included on the Matrix chart, (b) whether the Example-Matrix strategy aided in the quantity of ideas noted, (c) whether the Example Only strategy had utility for students, and (d) what the relationship was between ideas noted and recalled.

Research participants were drawn from students in grades eleven and twelve from schools in the Greater Victoria and Sooke Districts (N = 156). A total of 12 classes participated in the pretest, posttest, and retention sessions in conjunction with their attendance at training sessions. For each of the pretest, posttest, and training
sessions, students watched a videotaped lecture while writing notes that were collected immediately prior to their completing the cued-recall test. After a one-week delay, an identical cued-recall test was readministered to measure retention.

Correlational analyses at posttest found a relationship between ideas noted and recalled both across and within the four notetaking groups ($p < .001$). Analyses of covariance did not detect an advantage for the Example-Matrix group nor for the Example Only group for ideas noted ($p > .05$), nor for ideas recalled immediately ($p > .05$) and following a one-week delay ($p > .05$). Analyses of covariance did, however, detect the superiority of the Matrix Only group for ideas noted ($p < .001$), recalled ($p < .001$) and retained over a one-week period ($p < .001$).

In the closing chapter of this dissertation, limitations of the levels of processing theory are addressed in accounting for the seemingly contradictory findings. The relevancy of explaining these findings in terms of the encoding specificity principle and transfer-appropriate processing is discussed. Implications for theory and instructional practice are offered in addition to recommendations for future research.
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CHAPTER 1

Introduction

Notetaking during lectures is prevalent among students in the classroom at secondary schools and colleges. Despite this, students receive no formal instruction on how to write notes or review them effectively (Kiewra, 1988). Partly by tradition, students record information that they perceive to be important (Kiewra, 1987). The instructor is accustomed to seeing pens in the hands of students who write intently as a sign that they are actively involved in learning (Carrier, 1983).

Students write volumes of notes during their academic careers (Kiewra, 1987) for a variety of reasons. Students believe that the process of writing notes helps them to: (a) concentrate on the topic, (b) stay awake, (c) understand the structure of the information, and (d) learn the material for later recall (Isaacs, 1989). They also believe that having a written record of the lecture material is useful for revising, restructuring, and studying at a later date (Isaacs, 1989).

It is important to find out whether notetaking and review indeed help students to learn from a lecture and if so, how these activities can be made more effective. Benefits associated with reviewing one's notes are reported consistently in the literature (e.g., Hartley, 1983; Kiewra, 1985a). However, findings are inconsistent with regard to the advantage of notetaking in itself. Some researchers
have found evidence to support the position that notetaking facilitates learning (Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). Yet other evidence shows that notetaking does little to enhance the cognitive performance of learners (Henk & Stahl, 1985); indeed, in some studies it has been found to interfere with the encoding of information by learners (Hartley, 1983; Kiewra, 1985a).

It is useful to examine the content of students' notes to gauge the relationship between information that is recorded and points that are remembered following the lecture. The positive relationship between the quality of notes recorded by students and later cognitive performance is well documented (Einstein, Morris, & Smith, 1985; Kiewra & Fletcher, 1984; Kiewra, Mayer, Christensen, Kim, & Risch, 1991). Yet students commonly write incomplete notes (Kiewra, 1987), either paraphrasing a fragment of the critical lecture points or restating them verbatim.

Somewhat neglected in the literature is a focus on implementing notetaking strategies that help students to write organized and complete notes which facilitate learning from a lecture. Students possibly miss some of the significant points, not writing them down, as a result of paraphrasing or restating the information verbatim. It is important to examine new strategies to make notetaking and review more effective and the benefits more predictable for the encoding of information by learners.
The present research is aimed at teaching students effective notetaking and review strategies in order to improve their learning from a lecture. Attempts have been made to minimize the interference of previously learned notetaking skills by training the students to a level of mastery in their utilization of the new strategies. Specifically, a group of students was taught how to write lecture notes on a chart that provided them with the main topics listed as column and row headings. They were also trained to write examples of the new concepts, and to review the points that they recorded, making sure that they were consistent with the examples. It was hypothesized that the structural notetaking strategy in conjunction with the example review technique would facilitate learning from a lecture.

This hypothesis builds on the extant literature on notetaking which is reviewed in the next chapter. Details of the experimental methods are contained in Chapter 3. Chapter 4 describes the results of the study. Finally, Chapter 5 discusses the results of the study in light of research in the area and with respect to improving instructional practice.
CHAPTER 2
LITERATURE REVIEW

Empirical research in notetaking spans a period of sixty-nine years. Research as far back as Crawford (1925) reflects empirical interest in examining the importance of notetaking in learning from a lecture. A similar focus of inquiry forms the basis for a wellspring of recent research programs carried out by investigators such as Benton, Kiewra, Whitfill, and Dennison (1993), King (1992a), and Spires (1993).

Prior to analyzing the notetaking literature, it is important to describe the main functions of notetaking. DiVesta and Gray (1972) conceptualized notetaking as serving primarily two functions. First, the process of writing notes serves to enhance the encoding of information by learners. Second, notes serve as an external store of information for later study and learning.

This review of the empirical literature on notetaking is organized around these two functions. The discussion begins with an overview of the encoding function of notetaking which is followed by a review of studies that have addressed the topic of improving the encoding of notes. The discussion then moves to a review of the external storage function of notetaking. This in turn leads to the topic of improving note review. Finally, toward the end of the chapter, the encoding and external storage functions are
The Encoding Function of Notetaking

The encoding function is based on the idea that writing notes in the absence of review facilitates learning from a lecture. The benefit associated with the encoding function is measured by comparing the performance of students who listen to the lecture and write notes with learners who listen but do not write notes. Learners do not review their notes prior to completing the performance test following the lecture (Kiewra, 1989).

Investigations into the benefits associated with notetaking have been rooted in cognitive psychology (e.g., Peper & Mayer, 1978; Kiewra, 1991). Theories that have been predominant in the empirical literature on notetaking include generative views and depth of processing assumptions. The description of theory serves as a backdrop for reviewing studies that focus on notetaking strategies that help students to encode material more effectively.

Generative Views

Kiewra (1991) partitioned generative activity into two cognitive processes. The first process involves the building of external connections, and the second, involves the building of internal connections (Mayer, 1984; Peper and Mayer, 1978; 1986). Hypothetically, the learner builds external connections by linking new information with prior
knowledge and experience. Internal connections are formed by organizing information into a logical structure, linking together the points that are presented during a lecture, and also relating these points to prior knowledge and experience (Mayer, 1984). Even if links among lecture ideas are provided by the instructor, learners must recreate these connections in order for them to construct meaning that is consistent with what they have already learned (Wittrock, 1990).

Peper and Mayer (1978, 1986) and Shrager and Mayer (1989) hypothesize that notetaking is a generative activity. These researchers suggest that during notetaking, the learner builds external connections automatically. These connections facilitate the encoding of lecture material. More broadly, the generative effect indicates that an individual's active involvement in a task, or learning by "doing", facilitates the recall of to-be-remembered material more than does the passive reception of information (Slamecka & Graf, 1978).

Results from laboratory research conducted by Slamecka and Graf (1978) support the generative effect in learning. Participants were required to utter a stimulus word followed by its synonym for each item presented. Those in the generative condition were presented with the stimulus and a cue letter (e.g., "rapid-f") and those in the read condition with the stimulus and response words ("rapid-fast").
Findings indicated that the self-generated synonyms were better remembered than were those that were read. These results were robust across various encoding rules, testing procedures, and research designs. However, the generation effect has been criticized in the literature (Begg, Vinski, Frankovich, & Holgate, 1991; Slamecka & Katsaiti, 1987) showing that it is not as robust as studies by Slamecka and Graf (1978) lead one to believe. Within these constraints, the generative effect is hypothesized to be present during notetaking because writing notes is more active than simply listening to the information presented (Peper & Mayer, 1978, 1986). The hypothesis of encoding enhancement by the generative effects of notetaking is the focus of much of the literature which is reviewed next.

Much research has been conducted to examine the benefits of notetaking for encoding lecture content by learners. In a series of experiments, Peper and Mayer (1978, 1986) and Shrager and Mayer (1989) found that notetakers outperformed listeners on problem-solving tasks, but not on factual-based tests (Peper & Mayer, 1978, 1986; Shrager & Mayer, 1989). These results have led researchers to conclude that the benefits of notetaking may only be revealed by the learner's performance on generative tests such as problem-solving. In related research, Einstein et al. (1985) found that notetakers recalled more main ideas than listeners only. They also found that notetakers and
listeners both recalled a similar number of lower-order facts. These findings support the benefits of notetaking for the hierarchical organization and later retrieval of lecture material.

Although some studies offer support for the encoding benefits of notetaking, findings from others have not shown such effects (Kiewra, 1989). Building upon the work of Hartley (1983), Kiewra (1985a) used the voting method to tally 56 studies according to whether or not writing notes without review facilitated learning. Findings indicated that 33 studies supported the benefit of notetaking for learning; 21 showed no difference in performance between notetakers and listeners; and 2 revealed that notetaking impeded learning.

Similarly, Henk and Stahl (1985) conducted a meta-analysis of 14 studies to determine whether notetaking in itself enhances the recall of lecture material. Studies included in the meta-analysis were aimed at group comparisons of listening versus notetaking for recall performance in the absence of review. These researchers reported a mean effect size of .34 across 25 dependent measures which indicates that the benefits of notetaking for recall may be limited. This effect size suggests that, hypothetically, notetaking could increase the performance of an average individual by one-third of a standard deviation above the mean.
It is useful to examine these mixed findings from a methodological standpoint. One limitation of many notetaking studies is that they focus on how much is recalled versus what is recalled (Henk & Stahl, 1985). The 14 studies selected for the meta-analysis by Henk and Stahl included 25 dependent measures. Henk and Stahl did not report the types of tests constituting these 25 measures. A greater number of factual-based tests than generative would have resulted in suppressing the benefits associated with the encoding function, if such advantages are revealed only by generative tasks such as problem-solving (Peper & Mayer, 1978, 1986). Although the mixed results do not discredit the encoding function altogether, they have prompted researchers to reconceptualize generative processing during notetaking (e.g., Kiewra, 1985a).

**Depth of Processing Framework**

The qualitative manipulations of notetaking activity proposed by Kiewra (1985a) contribute to an understanding of whether encoding is enhanced by high generative processing during notetaking. In this portion of the review, a brief theoretical discussion of these points is followed by a review of research related to the depth of processing concept.

Kiewra (1985a) states that two concerns need consideration before assuming that notetaking automatically serves a generative function. First, evidence of generative
activity must be observable in student notes. Second, the degree of generative processing must be manipulated experimentally along a continuum. Craik and Lockhart (1972) hold that the retention of information is a function of the depth of processing. Greater depth is equated with a high degree of cognitive analysis involving factors such as the allocation of attentional resources and processing time. Extracting meaning or semantic analysis by the learner is associated with deep level processing; whereas, sensory analysis is equated with surface-level cognitions (Craik & Lockhart, 1972).

Kiewra, DuBois, et al. (1991) suggest that generative or deeper level encoding is restricted during notetaking. In a lecture situation, learners must listen to the presented material; discriminate between important points and unnecessary detail; hold and manipulate the ideas while interpreting them; and finally record the points. This places considerable demands on learners. Other constraining factors are present, such as lecture density, speed of delivery, and learners' writing speed (Ladas, 1980). With such constraints in place, shallow processing would be evident by verbatim or paraphrased notes detailing factual information as opposed to relational notes extending the main ideas to new situations (Kiewra & Fletcher, 1984).

Kiewra (1991) suggests that generative processing is more likely to occur during review than notetaking. He
suggests this is so because cognitive resources are freer during review than notetaking and that attentional processes are less diverted. These conjectures on the generative effect are appealing; however, they have not been substantiated by empirical research (Slamecka & Katsaili, 1987). On the basis of their empirical findings, Slamecka and Katsaili (1987) have criticized Craik and Lockhart's depth of processing model.

Slamecka and Katsaili (1987) conducted a series of experiments to investigate the generation effect on the later recall of response words from word-pairs presented in a mixed-lists or pure-lists format. For the pure-lists design, generators were instructed to read the stimulus word in the word-pair and to generate the response word using a cue letter (e.g., "rapid-f"). Readers were instructed to read the stimulus and response words for each word-pair upon its presentation (e.g., "rapid-fast"). For the mixed-lists design, half of the word-pairs were presented in the generate format and half in the read format in random order.

Slamecka and Katsaili (1987) found that the free recall of response words was better for the generate format than the read for the mixed-lists design only but not for the pure-lists. If the generation effect is said to involve greater cognitive effort, capacity, or attention requiring deeper semantic or conceptual processing, the superiority of the generate over the read condition would have been expected
for the pure-lists design. Slamecka and Katsaiti have ruled out these processing factors as constituting the generation effect for free recall performance on the basis that the generation effect should have been upheld by the pure-lists design in addition to the mixed-lists arrangement.

As mentioned earlier, depth of processing is explained by greater semantic processing involving increased cognitive effort, capacity, and focused attention (Craik & Lockhart, 1972). In contrast, generative strategy use is explained by the building of internal and external connections among new ideas and linking these ideas with prior knowledge and experience (Wittrock, 1990). Although research does not confirm that generative processing involves deeper semantic processing (Slamecka & Katsaiti, 1987), the generation effect does exist (Slamecka & Graf, 1978).

An alternative to Craik and Lockhart’s (1972) depth of processing continuum is a generative processing continuum of high versus low generative processing during notetaking (Kiewra & Fletcher, 1984). Generative strategy use aids learners in building more connections at one end of the processing continuum and fewer connections at the opposite end. Hypothetically, strategies that enhance high generative processing encourage learners to form more connections among lecture ideas as well as between these ideas and prior knowledge. Techniques of low generative processing facilitate the building of fewer connections
Kiewra (1989) points to the absence of empirical evidence to support the view that notetaking automatically serves a generative function. In particular, Peper and Mayer (1986) have been unsuccessful in finding specific evidence of generative activity in student notes. Generative activity was measured by linking the ideas recorded in learner notes with their answers on problem-solving items. Specifically, no relationships were observed between correct answers and related inferences in notes nor between incorrect responses and the absence of such inferences in notes. Kiewra (1989) reviewed 10 of the 33 studies cited in support of the encoding function. Notes had been analyzed in only three of the 10 studies; the focus of these analyses had not been on uncovering generative activity. It can be concluded that there is a paucity of research with a focus on measuring the level of generative activity in students' notes.

Kiewra and Fletcher (1984) were unsuccessful in their attempt to teach generative processing during notetaking. These researchers had instructed students to record either factual, conceptual, relational, or typical notes during pause time following lecture segments. Factual notes were a low generative activity, whereas relational notes reflected high-generative processing. Factual notetakers were instructed to record only detail; conceptual notetakers to
write only the main ideas; relational notetakers to link the main ideas with prior experience; and typical notetakers to write notes in their usual manner. Despite the differential notetaking instructions, all notes contained a similar number of conceptual ideas with supporting detail. Few learners wrote relational notes. Inclusion of a training phase by Kiewra and Fletcher would have perhaps facilitated their attempts to manipulate the levels of generative activity during notetaking.

In summary, the studies by Peper and Mayer (1978, 1986), Kiewra and Fletcher (1984), and those reviewed by Kiewra (1989) are limited in regard to showing evidence of generative encoding during notetaking. A review of other generative training studies appears in the next section which is on the topic of improving the encoding function of notetaking.

Improving Encoding During Notetaking

Researchers have been interested in how to structure material effectively to help students learn from a lecture (e.g., Kiewra, 1991; Morgan, Lilley, & Boreham, 1988). More specifically, investigators have provided students with structural aids that are aimed at helping learners to improve both the quality of their notes and the memory of to-be-recalled material. What follows is a review of research that examines: (a) the general utility of various aids given to students to improve the content of their
notes; and (b) the benefits of matrix, outline, and split-page strategies, specifically. Finally, comparative studies are reviewed, and the section closes with a summary of the encoding research.

**Improving Note Content**

Factors that limit the positive influence of notetaking include incomplete student notes and poor note quality (Kiewra, 1989). Einstein et al. (1985) as well as Kiewra and Fletcher (1984) have found a positive correlation between the number of ideas recorded by students and their test performance. Kiewra and Fletcher reported a correlation of .72 between test-related points in the notes of students and performance on an immediate test without review. Similarly, Einstein et al. found that students recalled 44% of the ideas that were noted but only 6% of the points that were not noted. These findings reported by Einstein et al. (1985) and Kiewra and Fletcher (1984) are correlational and not causal making them very ambiguous. The findings, therefore, do not suggest that notetaking causes good test performance, but that ideas noted are related to test performance along with various factors that are not specified. Even though notetaking appears to be related to test performance, however, students are notorious for writing incomplete notes (Kiewra, 1989). For example, university students were found to record 30% (Kiewra, 1985b) of the 115 lecture ideas in total or even as few as 20% of
them (Kiewra, 1985c).

Research conducted by Einstein et al. (1985) and Kiewra, Mayer et al. (1991) focused upon the quality of students' notes. In particular, research has been directed at uncovering the kinds of points that students write in their notes and subsequently recall in relation to ideas that are left out. In these studies, note content from the lecture was classified hierarchically. For instance, top-level information referred to main ideas and lower-order material to detailed facts. Results of both studies indicate that students tend to record and recall predominantly top-level information.

Furthermore, Kiewra, Mayer et al. (1991) studied whether notetakers altered this strategy when the lecture was repeated three times. Findings of their first experiment indicated that repeating the lecture helped students to recall top-level as well as lower-order information in the absence of review. Further results revealed that top-level information was well represented initially in students' notes and did not improve on subsequent trials. In contrast, lower-level facts were increased greatly in student notes on trials that were subsequent to the first. Hence, repeating the lecture helped students to shift their learning strategy away from recording top-level information toward embellishing their notes by adding lower-order points.
The studies cited in this subsection on improving note content are important in determining the characteristics of high quality notes that help learners to better encode information that is presented during a lecture. Such notes reflect a balance between recording top-level information that is presented and embellishing these main ideas with lower-order facts.

The literature has been directed toward determining instructional and learning strategies that are aimed at facilitating the encoding function (e.g., Kiewra, DuBois et al., 1991). The goal is to help students to write more complete and accurate notes that are organized hierarchically. Studies that focus on such learning strategies are reviewed next.

Matrix Strategy

The matrix technique is a spatial learning strategy. The linear information from the lecture presentation is reorganized by the learner onto a two-dimensional structure which shows the relationship among lecture ideas. The structure of the matrix is said to enhance the encoding and later retrieval of information by learners. This enhancement occurs during notetaking as a result of the learner: (a) organizing information into categories on the spatial representation; and (b) forming internal connections among the presented ideas by cross-referencing. The cross-referencing of each idea serves to provide the learner with
multiple cues for the later retrieval of information (Kiewra, 1988).

An example of matrix notes provided by Kiewra, DuBois et al. (1991) corresponds with a videotaped lecture on the topic of creativity. The matrix is on a single sheet of paper that is 38 x 20 centimeters. Column headings on the matrix name the five types of creativity (e.g., expressive, adaptive, innovative), and row headings list the nine dimensions (e.g., definition, distinguishing characteristics, myths). Learners record notes in the intersecting cells, which are empty. The recorded ideas are cross-referenced with column and side headings. The size of the cells vary in relation to the amount of information that is pertinent to each cell.

Research findings support matrix notetaking as an effective learning strategy. Kiewra, DuBois et al. (1991) have found the matrix technique useful for helping learners to write more complete notes and to recall content from the lecture (Kiewra, DuBois et al., 1991). Benton, Kiewra, Whitfill and Dennison (1993) report that matrix notetaking helps students to write cohesive essays immediately following a lecture. Cohesion was measured by summing the number of ideas that were linked as comparisons or contrasts in students’ essays.

Research on the effectiveness of the matrix strategy is limited to the work of Kiewra and his colleagues (e.g.,
Matrix notetaking is said to be impractical due to the high density of lecture material and a fast rate of delivery (Ladas, 1980). However, providing students with a matrix framework makes the strategy more practical than requiring the students to construct their own matrices. Further research is needed to provide evidence to confirm the apparent benefits of the matrix strategy.

Outline Strategy

In this strategy, outlines are provided for students to enhance their encoding of lecture material. One function of this aid is to provide structural support for the learner. Topical outlines serve to focus students' attention on relevant information, cuing them to write supporting points beneath each keynote (Kiewra, 1991). Topical outlines also reveal the organization of the lecture, therefore, functioning as advance organizers for subsequent lecture material (Glynn & DiVesta, 1977). The learners retrieve information about the main headings or topics organized on the outline. The prior knowledge that has been activated is then available for the learner to link with new information during the lecture as each topic is explained by the instructor (Peper & Mayer, 1978, 1986; Wittrock, 1990).

Linear notetaking is an example of an outline strategy that has been implemented by Kiewra, DuBois et al. (1991). The linear outline, like the matrix framework, corresponds
with the videotaped lecture on creativity. The linear outline is mimeographed onto four sheets of standard paper. The main topics on the outline are the five types of creativity; the nine dimensions are subtopics that are subsumed beneath each of the five types of creativity. Learners write notes in the empty spaces between the ideas on this topical outline. Results of studies conducted by Kiewra, DuBois, Christensen, Kim, and Lindberg (1989) as well as by Kiewra, DuBois et al. (1991) indicate that the linear strategy is useful for helping students to record more complete notes.

Frank, Garlinger, and Kiewra (1989) conducted a study to find out which combination of strategies involving embedded headings and an outline best facilitated student’s test performance. The main headings on the outline were parallel to the information that was presented in the videotaped lecture. Students wrote notes in the spaces between the ideas on the outline. The embedded headings on the videotaped lecture were identical to the main headings that appeared on the outline.

The two levels of the videotape condition were embedded headings versus no embedded headings. The two levels of the notetaking condition were outline versus no outline. Performance was favorable for students without strategies (control condition), and also for learners who were supplied with outlines containing headings identical to those
embedded in the videotaped lecture. However, participants without any structural support strategies fared better than did: (a) students using outlines without embedded headings, and (b) those using embedded headings without outlines. This finding indicates that the outline and embedded heading strategies on their own tend to interfere with comprehension-based learning.

These results reveal an advantage for combining the outline strategy with the use of headings. The topical outline serves as an advance organizer of the lecture content, helping to activate the learner's prior knowledge and to focus attention on relevant material. The embedded headings cue the learner to record pertinent information beneath the identical heading on the outline. Perhaps the topical outline on its own diverts learners' attention away from notetaking toward perusing information on the form; the headings alone are time-consuming to record and therefore possibly contribute to learners missing other important information to record in their notes.

In a related line of research, Morgan et al. (1988) explored the optimal amount of detail to include on an outline. Morgan et al. provided groups of participants with one of four outlines, each varying in detail. The outlines were as follows: (a) a verbatim script of the lecture; (b) headings and main ideas recorded in sentence format; (c) headings only; and (d) blank paper (control
condition). All outline variations included space for students to write notes.

Findings support the use of outline strategies without detailed information. These investigators found that recall was better for participants in the headings only group than for those in the condition of headings plus key points. In view of findings by Morgan et al. (1988), the more detailed outlines may have limited the benefits of encoding by: (a) diverting students' attention away from the lecture toward scanning the information on the form, and (b) curtailing notetaking.

The method used by Morgan et al. (1988) is somewhat weak. Specifically, the notes were returned to students with the assumption that they would not be reviewed prior to the unexpected test two days later. The superiority of the headings only condition could be due to the time spent studying rather than to the utility of the outline strategy. The notes should have been held until after the test to control for review. Hence, the reported results should be interpreted with caution.

On the basis of these studies, evidence is inconclusive for the utility of outline strategies. At most, it seems appropriate for instructors to provide outlines to students insofar as these structures correspond with headings that are signalled during the lecture. The headings could be written on the chalk board, for example (Kiewra, 1991),
cuing students to record notes beneath the identical headings on the outline.

**Split-Page Technique**

The work of Spires (1993) stands apart from other studies on the topic of notetaking. In particular, she built on the extant cognitive theory to include a metacognitive emphasis during notetaking. Her research was rooted in the idea that the encoding function would be facilitated by student's active participation in cognitive-based notetaking instruction as well as in metacognitive-based self-monitoring of their notetaking behaviors. On the basis of her theoretical perspective, Spires implemented the following three strategies: (a) explicit notetaking instruction; (b) explicit instruction with self-questioning; and (c) a control condition. Next is an overview of these strategies, followed by a review of the research findings.

Instruction for notetaking is centered on the split-page technique. This involves writing main ideas on the left side of the page and recording the supporting detail along with examples on the more expansive right hand side. Learners in the control group along with all other subjects were told how to use the split-page method.

Students in the explicit instruction group were guided in a stepwise fashion in the use of the split-page strategy. Spires borrowed the model of explicit instruction from Pearson and Gallagher (1983) and applied it to the delivery
of notetaking instruction. The five components of this model include the following: (a) explaining to students the utility of the split-page method; (b) modeling the strategy at the board; (c) working with students during strategy use; (d) modeling by peers with guided feedback; and (e) independent practice of the split-page method.

In addition to receiving explicit instruction for notetaking, a group of students received similar training for a self-questioning strategy (Spires & Stone, 1989). The self-given questions and answers were aimed at the following: (a) planning reasons for listening to the lecture; (b) monitoring their concentration; and (c) evaluating their need to clarify points. Spires (1993) predicted that explicit instruction plus self-questioning strategies would be superior to explicit instruction. In turn, explicit instruction was expected to fare better than the control condition.

The predictions were confirmed by students' performance on multiple-choice tests and by ratings of the quality of students' notes. Higher test scores and ratings for notes were achieved by students in the explicit instruction plus self-questioning condition than by students in either the explicit instruction or control groups. Students in the explicit instruction category received higher ratings for note quality than those in the control condition. In addition, Spires included an evaluative component in the
notetaking instruction by asking students to assess their confidence in recording effective notes following their training. Highest levels of confidence were reported by students in the explicit instruction plus self-questioning group and in the explicit instruction condition.

Spires' (1993) research adds to the body of literature about notetaking but is not without limitations. Spires contributed to the research by adapting a model for the delivery of notetaking instruction (Pearson & Gallagher, 1983), and by including student evaluations of the training component. Her work contrasts all studies reviewed thus far with regard to the importance placed on training students in notetaking strategies.

However, the main criticism involves the instrument used for measuring the quality of notes. Even though the split-page technique was the main factor in distinguishing between the groups for the effectiveness of notetaking instruction, it was allotted only five points out of 55 in total on the rating scale used to judge note quality. Other components of the scale include 10 points for rating the use of abbreviations and legibility, and 40 points for rating the accuracy of notetaking, sequencing, and clarity. Consequently, there is minimal evidence to show that participants have actually mastered the split-page strategy. An alternative for assessing the quality of learners' notes would be to: (a) implement a rating scale measuring various
components of the split-page method (Gronlund, 1993); and (b) total the number of idea units included in students' notes (e.g., Kiewra, DuBois et al., 1991; King, 1992a).

**Comparative Studies**

A few attempts have been made by researchers to contrast a number of strategies for taking notes (e.g., Kiewra et al., 1989; Kiewra, DuBois, et al., 1991). Three techniques in particular have received attention. These are providing the student with (a) matrix forms, (b) linear outlines, or (c) conventional materials for notetaking. Participants in the conventional group, the control condition, were supplied with four sheets of standard lined paper for notetaking (Kiewra et al., 1989; Kiewra, DuBois, et al., 1991).

As noted earlier, according to Kiewra (1991), the building of internal connections during notetaking would serve to improve the encoding of information by learners. Kiewra proposed that instructor-provided techniques such as the matrix and linear outlines were aimed at building internal connections. For example, in the use of these strategies with the creativity lecture described earlier, the structure and organization of the matrix assists learners in comparing myths about innovative creativity with myths about emergentative creativity or school creativity (see Appendix A). In contrast, learners using the outline are less likely to link the myths about innovative
creativity with myths for school creativity, for example, since these types appear on separate pages. On this basis, it was hypothesized that the formation of internal connections would be facilitated mostly by the matrix strategy followed by the linear technique and finally by conventional notetaking (Kiewra et al., 1989; Kiewra, DuBois et al., 1991). As a result, it was predicted that students’ test performance would follow the same pattern.

Findings of Kiewra et al. (1989) were inconsistent with those of Kiewra, DuBois et al. (1991). In the study by Kiewra et al. (1989), researchers found that students’ performance was similar regardless of whether they wrote matrix, linear, or conventional notes. The three performance tests were designed to measure the student’s ability to (a) recall, unassisted, the presented information about creativity (free-recall); (b) recognize facts; and (c) synthesize and apply the lecture ideas. In the later study, Kiewra, DuBois et al. (1991) reused the test of synthesis. However, instead of the free-recall test, they used a measure that included the types and dimensions of creativity on the form (cued-recall). These researchers found that matrix notetakers scored higher on the test of cued-recall than did those in the conventional group. Performance on the synthesis test did not differ regardless of the notetaking strategy.

The discrepancy between the findings reported by Kiewra
et al. (1989) and Kiewra, DuBois et al. (1991) are in line with the encoding specificity principle (Tulving, 1983) or the more general theory of transfer-appropriate processing (Roediger, Weldon, & Challis, 1989). The encoding specificity principle refers to the notion that encoding is more likely to foster good test performance if the conditions at retrieval and encoding are closely matched. The general idea is that a close match between the two conditions is likely to enhance the transfer of information encoded to the test situation (Roediger et al., 1989).

The discrepancy in the studies by Kiewra et al. (1989) and Kiewra, DuBois et al. (1991) is that students performed better on the cued-recall test as opposed to free-recall after recording notes on a matrix framework. The cues present at encoding while recording notes on the matrix matched those at retrieval on the cued-recall test, but were not included on the free-recall test. The cues present during encoding and retrieval served to facilitate the transfer of the encoded material to benefit students' cued-recall performance for the Matrix notetaking group.

It was also predicted that the use of matrix and linear strategies would result in more complete notes than the conventional format (Kiewra et al., 1989; Kiewra, DuBois, et al., 1991). This hypothesis was confirmed. Kiewra et al. (1989) reported that linear notes contained significantly more lecture ideas (M = 51), from a total of 121, than did
conventional notes (M = 42). Corroborating results of Kiewra, DuBois et al. (1991) revealed that both matrix and linear notetakers recorded more idea units than did conventional notetakers (M = 57.1, 56.4, and 38.3, respectively). In light of these findings, it appears that the structure provided by the matrix and linear strategies helps students to record more detail than they would otherwise.

A shortcoming of the comparative studies is that students received no training for strategy use. In these studies, the cued-recall test was the most sensitive measure in detecting the benefits of the matrix strategy in the absence of training. Further research is needed to substantiate the utility of the matrix strategy.

**Summary of Encoding Research**

In summary, the methodology is generally weak in the notetaking studies that have been reviewed here. Evidence in support of generative encoding highlights the importance of the matrix framework (Kiewra, DuBois et al., 1991) in helping learners to build internal connections (Mayer, 1984) among points from a lecture. These links facilitate students' performance on the cued-recall test. The layout of main points in the form of a matrix helps students to record more complete notes with a balance of top- and lower-level information.

Techniques such as providing the student with an
outline in the absence of other strategies serves to hinder cognitive performance (Frank et al., 1989). The impeded learning is due perhaps in part to the lack of notetaking training. In fact, notetaking strategies have been implemented by several researchers (e.g., Kiewra, DuBois et al., 1991; Morgan et al., 1988), yet they have not collected evidence to show that the strategy has actually been used by the students.

A final word is that the literature awaits a study that is methodologically stronger on two main dimensions. First, it is important that students are trained in the notetaking strategy that is being examined. Second, it is advisable to establish a selection criterion to ensure students' mastery of the strategy as a result of training and also to ensure that the strategies are used. On this note, the discussion turns to a review of the literature directed at the external storage function.

The External Storage Function of Notetaking

The external storage function suggests that learning is facilitated by reviewing a set of notes that are stored in written form. These notes can be recorded personally (Kiewra, 1989), provided by the instructor (Kiewra, DuBois, Christian, & McShane, 1988), or borrowed from peers (Kiewra, DuBois, et al., 1991). Regardless of the source, the utility of external storage is measured by comparing the performance of students who review a set of notes with
learners who are not permitted to review (Kiewra, 1989).

The literature is remarkably straightforward with regard to assessing the external storage function of notetaking. A total of 22 studies were surveyed by Hartley (1983) and Kiewra (1985a). Results from 17 of the studies revealed higher scores for students who reviewed notes than for those who did not. The performance was similar for reviewers and nonreviewers in five of the studies. None of the studies indicated that review impedes learning. In support of the review function, an effect size estimate of 1.56 was reported by Henk and Stahl (1985). With empirical evidence that supports the utility of the external storage function, the literature shifts to a focus on improving note review.

Improving the External Storage Function

In the literature, two main branches of research examine techniques that are aimed at improving deferred learning at the time of review. The first branch addresses the poor quality of students' notes. It is aimed at improving encoding by providing students with instructors' notes for review (e.g., Kiewra, 1985b, 1985c; Maqsud, 1980). The second branch is directed at improving generative encoding by providing students with various strategies to employ during review (King, 1992a). Each branch is discussed in turn.

Instructor-Provided Notes
This section begins with a review of studies in which students are provided with a general set of notes provided by the instructor (Kiewra, 1985b; 1985c; Maqsud, 1980). Then research is reviewed in which students were provided with notes in various formats (Benton et al., 1993; Kiewra et al., 1988).

**General notes.** Maqsud (1980) was interested in finding out the effects of four conditions of reviewing notes on free-recall performance. The free-recall test was completed by students following a 30-minute review period that occurred seven days after the lecture. Findings indicated that reviewing the instructor's handout plus personal notes was the most effective condition. The handout contained a detailed and organized record of the lecture. The next most useful condition was reviewing the instructor's handout only, then personal notes only. Finally, a mental review of the lecture was least effective. One shortcoming of the study is that Maqsud (1980) did not test for differences in performance between listeners and notetakers immediately following the lecture. Hence, the apparent advantage of reviewing the instructor's handout rather than personal notes could be due to encoding differences between notetakers and listeners during the lecture.

Kiewra (1985c) ensured that encoding via notetaking or listening to the lecture was assessed independent of review in his investigation into the utility of providing students
with notes for review. Notetakers and listeners were assessed following the lecture and were found to perform similarly on factual-based test items. Results of an exam administered two days later indicated that achievement was higher on factual items for listeners reviewing instructor-provided notes than for notetakers reviewing their own personal notes.

Kiewra (1985b) reported similar findings as a result of his investigation into the benefits of instructor-provided notes for review. His study included the following seven notetaking conditions: (a) notetaking and review of both personal and instructor-provided notes; (b) listening and reviewing the instructor’s notes; (c) reviewing the instructor’s notes without attending the lecture; (d) notetaking and reviewing personal notes; (e) notetaking and reviewing mentally; (f) listening and reviewing mentally; and (g) not reviewing and not attending the lecture. The review session occurred prior to the delayed exam, which was two days after the lecture.

Findings reported by Kiewra (1985b) indicated that achievement on factual test items was highest for the three groups that reviewed instructor-provided notes. Achievement was lowest for the three groups without any notes to review. Achievement was lower for notetakers reviewing their own notes than for: (a) notetakers reviewing their personal notes in conjunction with instructor-provided notes, or (b)
those absent from the lecture reviewing instructor-provided notes. Notetakers reviewing their personal notes scored higher than only those students without notes to review who did not attend the lecture.

In summary, it is useful to provide students with a copy of the instructor’s notes because they are generally detailed, organized, and complete (Kiewra, 1985b, 1985c). Also, provided notes include ideas from the lecture that the instructor believes to be important and hence tests students for retention. Items specific to the test are contained in the instructor’s notes but may not be included in the student’s record (Kiewra, 1985b, 1985c, 1989). The provided notes help the students to review points that they may have omitted in their own record (Maqsud, 1980) and also help them to correct errors of commission (Kiewra, 1989). Inquiry into the optimal type of instructor-provided notes is reviewed next.

Structured notes. The purpose of the study by Kiewra, et al. (1988) was to determine which form of instructor-provided notes enhances test performance. The three structures are identical to those discussed earlier from the work of Kiewra, DuBois, et al. (1991) and include a transcript of the lecture in the form of a matrix, outline, or full text (conventional). These notes were provided for review one week after students listened to the lecture. Kiewra, et al. (1988) hypothesized that reviewing matrix or
outline notes, respectively, would be valuable in helping learners to build internal connections among the presented ideas (Mayer, 1984).

The hypothesis was supported by higher performance on cued-recall for students reviewing either matrix or outline notes as opposed to conventional. In addition, those who reviewed matrix notes obtained higher scores than reviewers of conventional notes for a test that required students to synthesize and apply lecture ideas. Further evidence in favor of reviewing matrix notes comes from the research of Benton et al. (1993). In the review period, students were required to write an essay that compared and contrasted ideas presented in a lecture one week earlier. These authors reported that students wrote more organized essays while reviewing matrix notes that were provided by the instructor.

A problem with providing notes as a structural aid is that, generally, instructors do not distribute their notes to students. Rather, notetaking is considered to be the responsibility of students (Kiewra, 1989). A more realistic approach would be to help students use effective strategies for reviewing their notes.

Generative Encoding Strategies

King (1992a) has examined the value of teaching students review strategies such as summarizing the lecture material or generating questions and answers. King’s review
strategies were aimed at prompting students to generate verbal elaborations (Anderson, 1990; King, 1992b; Wittrock, 1990) of new points presented in the lecture. It is possible that self-generated elaborations facilitate memory by providing the learner with alternative retrieval pathways for recall, as well as with a basis upon which to reconstruct and infer forgotten information (Anderson, 1990). A description of the two elaborative strategies used in King's (1992a) study precedes a review of King's findings.

Following each of four videotaped lectures, students were taught to review their notes and the provided aids to generate questions and answers about the lecture material. The aids consisted of partial questions that were generic or free of content. An example is "What is the best...and why?" or "how does...affect...?" (King, 1992a, p. 309). In order to generate questions and answers, students were taught to build links among ideas in the lecture, prompting them to activate their prior knowledge and experience.

The other strategy consisted of teaching the students to select the main points of the lecture from their notes and to generate a summary by linking the ideas together in their own words. They were provided with an aid that consisted of rules for generating the summaries. The rules involved two steps: (a) identifying the main topic of the lecture before using it to write the first sentence; and (b)
identifying a subtopic along with related points before joining the ideas to write the next sentence. This latter step was repeated for each successive sentence until the summary was complete. Students in the control condition, called notetaking-review, practiced writing notes and reviewing them in their usual manner. They received no training.

King (1992a) did not manipulate the students' styles of notetaking. In the study, all students wrote notes in their usual manner. The focus of her study involved varying the three conditions of note review: summarizing, self-questioning, and note-taking-review.

Results indicated that those who generated summaries of the lecture and those using the self-questioning strategy both outperformed the control subjects. These results pertained to performance on a multiple-choice test that was administered immediately following the lecture. An alternate form of the test was administered one week later. On the delayed test, only the self-questioners outperformed the note-reviewers. In general, self-questioning appeared to be a useful strategy for facilitating the generative encoding of lecture material during the student's review period.

Summary of the External Storage Function

Not until recently has the direction of the literature moved away from providing students with general (Kiewra,
1985b, 1985c) or structured (Kiewra et al., 1988) notes for review toward equipping them with effective study strategies (King, 1992a). As a result, the topic of helping students to use effective review strategies for encoding lecture material has been relatively untouched. Also, the study period occurred after the lecture in all of the studies that were reviewed. The literature is virtually silent with regard to examining the benefits of embedding strategies for review within segments of the lecture.

There is a need for studies that are aimed at uncovering the utility of elaborative strategies such as students' examples, metaphors, or analogues that are generated during review. These strategies could be explored in addition to or in combination with the self-questioning and summary strategies examined by King (1992a). Also, future studies can be improved by including a criterion for measuring the student's utilization of the assigned study strategy. King did attempt to address this issue indirectly by including the student's self-reports of strategy utilization as well as experimenter's observations. These considerations lead to the last section of the literature review.

The Encoding Plus External Storage Function

The literature has moved in the direction of providing students with strategies aimed at improving the quality of their notes toward the goal of effective learning. To meet
this goal, the literature needs to move away from a focus on either notetaking or review by looking at the instructional utility of bringing these two functions together (Kiewra, 1989). In fact, Kiewra, DuBois et al. (1991) found that the generative encoding of lecture material was strengthened by writing notes in concert with reviewing them. In the present study, students are provided with a matrix framework aimed at building internal connections during notetaking (Kiewra, 1991), and with an example strategy (Kiewra, 1991; Wittrock, 1990) directed at building external connections during review. The review segments are embedded into the lecture.

It is hypothesized that orchestrating the notetaking and review strategies will result in a greater number of elaborations being generated by the students. In particular, it is predicted that encoding will be facilitated by students recording notes on a matrix in conjunction with reviewing them by generating examples. The use of the matrix technique and the example strategy, in combination, is predicted to be advantageous over using one strategy in the absence of the other. This prediction leads to a statement of research questions addressed in this thesis.

Research Questions
1. Does matrix notetaking plus writing examples for review enhance students' performance on a cued-recall test more
than the presence of one strategy in the absence of the other?

2. Does the review strategy of writing examples improve students' cued-recall performance without any special notetaking strategy?

3. Are more ideas recorded by those who write matrix notes plus review their notes by generating examples compared to those who use one strategy in the absence of the other?

4. Does a relationship exist between scores for various dependent measures? For example, between the percentage of idea units contained in students' notes at posttest and the percentage recalled at posttest.
CHAPTER 3
Method

Subjects

Initially, 481 students from secondary schools in Victoria participated in the study. The sample size was reduced to 156 students. The overall number of cases that were deleted (n = 325) had missing data for the pretest, posttest, or retention test sessions (n = 225); had not met the selection criterion of 83% mastery for strategy utilization (n = 96); or had scores that were far outside values in the preliminary data analyses (n = 4). After cases were removed, the smallest treatment condition consisted of 39 students. Cases from the other three groups were selected at random by computer to obtain four groups of equal size each consisting of 39 students (n = 156).

Drop-outs were similar in number from the initial (n = 481) to the reduced sample (n = 156) across the factors of Grade (Eleven, n = 218; Twelve, n = 107), Course (English, n = 262; Psychology, n = 63), and School (Belmont, n = 69; Spectrum, n = 32; Reynolds, n = 161; and Mount Douglas, n = 63). Gender differences, however, were detected in the number of drop-outs from the study (Females, n = 162; Males, n = 163). The ratio of 54:46 for the percent of females to males at the outset of the study dropped significantly to 62:38, $\chi^2(1, N = 156) = 4.19, p < .05$.

The final sample of 156 students consisted of 97
females and 59 males in grades 11 (n = 114) or 12 (n = 42) from classes in either English (n = 127) or Psychology (n = 29). They were from either Belmont (n = 46), Spectrum (n = 14), Reynolds (n = 67), or Mount Douglas (n = 29) schools.

A total of 12 classes participated in the study. The classes were assigned randomly to four notetaking groups. Participants in the first group, using the Example-Matrix strategy, wrote notes on the matrix framework and reviewed them by writing examples. Students in the Example Only group wrote notes in their usual manner and reviewed them by writing examples. Those in the Matrix Only group wrote notes on the matrix framework and reviewed them in their usual manner. Students in the forth group, Conventional Notetaking, wrote notes in their usual manner and also reviewed them this way. Each notetaking group was represented by classes from at least two schools.

Materials and Instruments

Videotaped Lectures

A 19-minute videotaped lecture on the topic of creativity, developed by Kiewra, DuBois et al. (1991), was used in the study. The lecture consisted of 1,881 words, 121 idea units, and was presented at an average rate of 100 words per minute. An idea unit is the semantic structure of text that is either expressed explicitly or inferred during interpretation (Kintsch & van Dijk, 1978). The following example of an idea unit is taken from the scoring protocol
on adaptive creativity that was received via personal correspondence with Kiewra: "Ability to use past knowledge and strategies to accommodate to problem-solving situations". The semantic structure of this text explicitly states that adaptive creativity is the use of knowledge and strategies to resolve problems. The inference is that these people apply their knowledge, skills, and experience to cope with an unexpected problem.

For the present study, the videotaped lecture was divided into two parts. The first part included material about expressive and adaptive creativity and was used during the pretest phase of the study. It was eight minutes long and included 58 of the 121 idea units. The second part included the topics of inr >vative, emergentative, and school creativity and was used during the posttest session. It was 11 minutes long and included 63 idea units.

The author developed three 10-minute videotaped lectures for the training sessions. The first one was on the topic of assertion (Alberti & Emmons, 1974), and the second and third tapes were on irrational thinking (Adler & Towne, 1990; Ellis, 1962). The structure of phrases and cues on the protocol for creativity was used in the development of idea units for each of the three training tapes. The videotape on assertion contained 58 idea units, and those on the topic of irrational thinking contained 56 idea units for the first tape and 57 for the second tape.
The scoring protocol for each of the three training tapes was an overlay of the protocol for creativity that was provided by Kiewra through personal correspondence.

**Notetaking Forms**

During the pretest, all participants received one sheet of lined paper for notetaking. For each of the training and posttest sessions, students in the Conventional group each received one sheet of lined paper. Participants in the Example group each received a sheet of lined paper with a margin measuring six centimeters on the right hand side of the page. Students in the Example-Matrix and Matrix notetaking groups were each provided with a matrix framework on a single sheet of paper measuring 38 X 20 centimeters.

The matrix corresponded with the videotaped lecture on creativity for the posttest (Kiewra, DuBois et al., 1991) and on assertion and irrational beliefs for the three training sessions (see Appendices A, B, C, and D, respectively). Innovative, emergentative and school creativity appeared along the horizontal axis of the matrix, and nine dimensions that described these types of creativity were listed along the vertical axis. These dimensions included the following: a) definition; b) time demand to display creativity; c) time demand to develop creativity; d) motivation; e) distinguishing characteristics; f) related characteristics; g) examples; h) myths; and i) myths expelled. The size of the empty spaces on the matrix varied...
according to the amount of material that was to be recorded. The types of creativity appearing on the horizontal axis of the matrix were replaced with the types of assertion for the first training session and with the types of irrational beliefs for the second and third sessions.

**Performance Measures**

The four performance measures included: (a) cued-recall tests; (b) analyses of note content; (c) an inventory of prior notetaking skills; and (d) an evaluation of strategy utilization. Each of these measures is described next.

*Cued-recall test.* Six cued-recall tests were used in the present study and were the same as the cued-recall test described by Kiewra, DuBois et al. (1991). A cued-recall test was administered at the end of each session. The directions on each of the recall tests included the types and dimensions of the behaviour. These types and dimensions served as cues that were identical to those presented in the lecture and listed on the provided matrix frameworks. The number of idea units recalled on the tests were converted to percentages.

The pretest for the lecture material on creativity was administered to assess the equivalency of groups for the recall of lecture material. The directions on the form named expressive and adaptive creativity and included the nine dimensions (see Appendix E). Students were given ten minutes to complete the test, which was the same amount of
time as the lecture. There were 58 idea units possible for recall on the pretest.

The posttest and retention test on creativity were identical. They measured differences among groups for recall as a result of training. The posttest was administered immediately following the lecture on creativity, and the retention test was administered one week after the posttest. Directions on the form named innovative, emergentative, and school creativity along with the nine dimensions (see Appendix F). Again, students were given 10 minutes to complete the test on each of the two occasions. The total number of idea units possible for recall was 63 for each test.

A cued-recall test was administered at the end of each training session to monitor students' performance as a result of training. Directions on the test for the first training tape named nonassertive, assertive, and aggressive behaviour along with the dimensions (see Appendix G). The total number of idea units for recall was 58. On the second test, the fallacies of perfection, approval, and overgeneralization were included in the directions (see Appendix H). The possible number of idea units was 56. Finally, the third test included the fallacies of causation, helplessness, and catastrophic expectations in the directions and also the nine dimensions (see Appendix I). The total number of idea units was 57. Students were given
10 minutes to complete each of the three tests.

**Note quality.** Notes were recorded by students on five different occasions while viewing a videotaped lecture (pretest, three training sessions, and posttest). Their notes were collected after each of the five videotaped lectures, but prior to administering the cued-recall test. The number of idea units recorded on the notetaking protocols were converted to percentages. The total number of ideas possible to include in students' notes during each of the five lectures was identical to the total number for recall as already mentioned. The purpose of the analysis at pretest was to assess for equivalency among groups in the percentage of ideas contained in students' notes. The content of students' notes was analyzed for each of the three training sessions to monitor student participation in using their assigned strategy. Notes from the posttest session were examined to assess for group differences in the percentage of idea units that were recorded.

**Notetaking inventory.** The Notetaking Inventory was administered at the pretraining session to assess the group's perceptions of their notetaking skills prior to carrying out the study (see Appendix J). This four-item inventory was developed by the researcher on the basis of notetaking and review practices that were outlined in the literature (e.g., Kiewra, DuBois et al., 1991; King, 1992a; Kiewra & Fletcher, 1984).
The first item assesses students' reports of how often they write notes. The second item assesses whether students write notes while listening to the videotaped lecture (i.e., concurrent notetaking) or whether they listen to a segment of the lecture prior to writing notes (segmented notetaking). The third item measures the type of information included in students' notes in conjunction with their personal notetaking styles. The fourth item measures the student's reported strategy for review.

Scoring consisted of tabulating the frequency of student responses for the four items on the inventory. For example, for the first item on the inventory, frequencies were tabulated for student responses to self-reports of how often they take notes. The greatest frequency of student responses could be for the category "sometimes", for example, whereas the least frequent category of student responses could be "hardly ever".

Notetaking evaluation. Students completed a 3-item attitude scale (see Appendix K). This scale was developed by the researcher. Its purpose was to assess students' perceptions of the effectiveness of the notetaking training. Students' responses on the Evaluation Form were scored as one, indicating "yes", or zero, meaning "no".

In addition, students' notes were examined for evidence of strategy utilization. A minimum selection criterion of 83% accurate strategy utilization was used for all training
groups. Any students who did not achieve the criterion level in one of the three training sessions for their assigned strategy were dropped from the study. Those in the Example-Matrix group were required to demonstrate the 83% criterion for each of the two strategies.

Scoring criteria for both the Example and Matrix strategies were one point, a half, or zero, depending on the accuracy of strategy use. For the Example strategy, one point was awarded for a correct example, a half point for an incorrect example, and zero for a missing example. The maximum score for each of the three training sessions was three. The criterion of 83% mastery was demonstrated by a score of two-and-one-half points out of three for any one of the three training sessions. For the Matrix strategy, one point was awarded for accurate idea units recorded in the cell, a half point for inaccurate ideas written in the cell, and zero for either a blank cell requiring ideas or ideas in a cell intended to be empty. The maximum score for each of the three training sessions was 27. Mastery was demonstrated by a score of 22.5 out of 27 (83%) for any one of the three training sessions.

Procedures

Prior to conducting the research, a pilot sample of six secondary students participated in the pretraining, training, and posttraining components of the study. They were taught how to use the matrix strategy for notetaking
and the example technique for reviewing their notes. The participants commented that the materials and procedures were clear. The number of ideas that were recorded in the notes of these students and later recalled by them improved from the pretraining to the posttraining session. The materials and procedures were deemed effective; therefore, the research project was initiated.

Data were collected from September, 1993, to March, 1994. The training and testing phases of the experiment involved four-and-one-half hours of class time, a total of six sessions. The author along with a research assistant visited each class two or three times per week for two weeks and returned on the third week for a final session.

Prior to classroom visits, letters of information (see Appendix L) were given to the classroom teachers for distribution to the students. Class lists were obtained and numbers were assigned to each student. Scheduling was arranged with the teachers, and each class was visited during the morning and afternoon periods. The experiment consisted of four parts for each class: pretraining, training, posttraining, and retention testing. Each part of the procedure is described in turn and applies to all the classes that participated in the study.

Pretesting

The pretraining session was 35 minutes in duration. The classroom teacher introduced the researcher and research
assistant to the class by saying that we were from the University of Victoria doing work in notetaking. After the introduction, the teacher left the room for the rest of the session.

As an introduction, the researcher explained briefly that she was interested in learning about how students write notes and also in finding out the best strategy for notetaking. The researcher suggested that there was no right or wrong way to write notes; that their performance was not part of their school marks; and that the information would be used only for research purposes. They were informed that she would be working with them for a portion of six classes over the period of three weeks. The students were reminded that they could withdraw from the study at any time.

Names on the class lists were called, and students were given their packages, by number, containing the pretest material. Students were told that they would write notes while listening to a videotaped lecture on creativity that included two parts: expressive and adaptive creativity. The steps that the students were expected to follow were displayed on a chart and were explained to them. The steps were then carried out sequentially and are explained next.

The students listened to the four-minute segment on expressive creativity while writing notes. They then reviewed their notes for a period of four minutes. They
wrote notes again while listening to the four-minute segment on adaptive creativity and reviewed their notes for a period of four minutes. Notes were collected from the students, and they completed the 10-minute cued-recall test on creativity. Finally, students completed the notetaking inventory. The completed tests and inventories were collected at the end of the pretest session.

Training

The training component involved three sessions that were each one hour in duration. All training was carried out by the author. Teachers were not present in the classrooms. A research assistant observed the sessions and noted the clarity of the teaching and the participation of students in utilizing the strategy being taught. At the beginning of each training session, names on the class lists were called, and students were given their corresponding numbered package containing the training material. At the end of each training session, the students’ notes were collected. The students then completed a 10-minute cued-recall test of information that was presented in the videotaped lecture. The tests were collected upon completion.

The method of explicit instruction was used to teach students their respective notetaking strategies (Spires & Stone, 1989). This method is based on the notion that learning takes place with guided support from the instructor.
In the present study, learners were taught how to use the treatment strategy until they demonstrated mastery of it. The structured support involved the following four guidelines: a) explaining to the students the utility of the strategy; b) modeling the strategy for the students; c) peer modelling with guided feedback; and finally, d) independent practice.

Participants in all four notetaking groups were given equal attention. The procedures followed for each notetaking strategy are outlined next.

**Matrix strategy.** In the first training session for the Matrix Only group, the author explained the utility of the matrix strategy for notetaking. Students were told that the matrix strategy has been found to help students to write more complete, organized notes and to recall lecture information. Next, the author modelled the strategy of matrix notetaking. A large matrix framework was drawn on the board in the view of all students. Notes were written in the cells that corresponded with the types and dimensions of assertion.

The steps involved in writing the notes were as follows. The author began the videotape on nonassertive behaviour and paused it after hearing information that corresponded with the definition. The author spoke aloud saying, "The speaker begins by explaining nonassertive behaviour so that must be the definition; 'definition'
appears here, along the side, so I must write it here in this space." The definition was then written in the relevant space. The tape was continued and was paused again after the next set of ideas. Again, the author made the thinking explicit by saying, "The speaker goes on to talk about the distinguishing characteristics which appear along the side down here, so the points belong, here, in this space." The points were recorded in the relevant spot. The tape was continued, but this time the author wrote notes while the tape was playing. The tape was then paused, and again thinking was made explicit by saying, "The lecturer gave some examples, and 'examples' appears along the side, here, so notes were recorded in this space." The pattern continued in which the author wrote notes in one or two of the empty cells and then paused the tape while using the think aloud technique.

At the end of the four-minute segment on nonassertive behaviour, the recorded points were reviewed with the students. After the review, the think aloud technique was used to model notetaking on the matrix at the board for assertive behaviour followed by a review session. Finally, matrix notetaking was modelled for the topic of aggressive behaviour. This was followed by a review session.

Peer modelling with guided feedback was the focus of the second training session. The first videotaped lecture on irrational thinking was used for this purpose. A large
matrix framework was drawn on the board in a position that could be seen by all students. The author started the videotape on the "fallacy of perfection" and paused it after hearing information that corresponded with the definition. The student stated what he or she was thinking while deciding where on the matrix to record the points. The tape was continued while the student wrote notes and was paused again after the next set of ideas. The student was asked to say what he or she was thinking while writing the notes. If the points were written in the incorrect space, the student was guided to make the correction. Also, for variation, the tape was paused at times and students were asked where they were recording the information and how they knew that the material belonged there.

At the end of the four-minute segment on perfection, the student reviewed aloud the points that were written on the matrix. After the review, the student was seated and another volunteered to write notes at the board. The "think aloud" technique was used again for the peer modelling of matrix notetaking and review for the fallacy of approval. The student was seated and the same procedure was followed for the fallacy of overgeneralization.

The third training session provided individual practice. A second tape on irrational beliefs was used. The first segment of the videotape was about the fallacy of causation. Students wrote notes on the matrix at their
seats in the absence of modelling. The author paused the tape at intermittent points, asking students where they wrote the points; how they knew where to write them; and what the cues were.

At the end of the segment on causation, the author showed an overhead transparency of points noted on the matrix. The notes on the overhead were reviewed aloud. This overhead provided students with corrective feedback on an individual basis. The procedure of starting the tape, pausing it, and posing guided questions was carried out as well for the fallacy of helplessness and catastrophic expectations. As before, points were reviewed on the overhead at the end of each segment.

**Example strategy.** Students in the Example Only group were told that they would use the example strategy to review their notes. The purpose of writing examples, they were told, was to help them to understand the new ideas that were being taught (Mayer, 1984; Wittrock, 1990).

The assertion tape was used in the first training session as an aid to model the example strategy to students. The author drew a vertical line on the board to represent a space for notetaking on the left side of the line and a column for the examples on the right side. The videotaped segment on nonassertive behaviour was started, and a volunteer wrote notes at the board. Students at their desks recorded notes on the left side of their page.
At the end of the segment on nonassertive behaviour, the volunteer returned to his or her desk, and the students were referred to a set of rules for writing examples (see Appendix M). The author talked aloud while generating an example by saying, "What is the new idea that the speaker has been talking about?" The writer then pointed to the board saying, "The new idea is nonassertive behaviour. What is meant by nonassertive behaviour?" The author read aloud some points on the board that helped to clarify further the concept of nonassertive behaviour (e.g., passive, overaccommodating, others choose for them). Then the comment was, "Let me see, what would be an example of someone being passive, overaccommodating, and others choosing for them. How about lending clothes to a friend when the person does not want to." The author then wrote the example to the right of the vertical line on the board and said, "How do I know that this example is actually right? Well, the person would be acting passive to lend the clothes; overaccommodating to meet the needs of the friend; and allowing the friend to choose who was entitled to wear the clothes." The writer placed a checkmark beside each of the three points as it was restated.

The students were guided to write the example of nonassertive behaviour in the column to the right of the page or to generate their own example and to check it back to make sure that it was correct. Then, another volunteer
wrote notes at the board for assertive behaviour and the author modelled the review strategy again. Finally, another volunteer wrote notes at the board for aggressive behaviour. The class participated in the review by thinking aloud, systematically, in response to the stated rules for writing examples.

The videotape on irrational thinking was used once again for peer modelling during the second training session. A volunteer wrote notes at the board on the topic of perfection. Peers wrote notes at their desks. The volunteer then wrote an example at the board while referring to the rules. Students at their seats wrote their own examples. The author circulated the room, checking student-generated examples. The research assistant observed unobtrusively whether check marks were being placed on the page accurately. The student at the board was asked to say what he or she was thinking for each of the four steps involved in writing the example. The student was instructed to checkmark the point that was noted as it was being checked for its consistency with the example. If a point did not fit the example, corrective feedback was offered and the example was adjusted.

The same procedure was used for the segment on the fallacy of approval and the fallacy of overgeneralization. A student volunteered to write notes on the board and to review the notes by writing an example. Peers wrote notes
at their desks and then generated examples by referring to the rules. Students at the board cooperated in saying what they had been thinking while writing the example.

In the third training session, the second tape on irrational thinking was used for guided individual practice. Students wrote notes at their desks and reviewed their notes by writing examples. Generally, they remembered the rules and, therefore, no longer referred to the sheet. Feedback on the student-generated examples was offered on an individual basis while the researcher walked about the room. After checking the work of individual students, volunteers raised their hand offering examples along with the steps that they used in generating them.

**Example-matrix strategy.** Students in the Example Matrix group were given the same information about the utility of the strategy as were those in both the Matrix Only and Example Only groups. Also, the procedures apply that were outlined for the matrix notetaking strategy as well as for the example review technique. The only difference is that the students wrote examples in a large empty space on the left side of the matrix rather than in a margin to the right of the page.

**Conventional strategy.** Learners in the Conventional Notetaking group were directed to use their own notetaking and review strategies. Learners were told that they would likely benefit from reflecting on their notetaking skills
and discussing them with peers. They participated in activities such as answering questions about personal notetaking strategies (see Appendix N); discussing these strategies in groups; setting goals for notetaking; and engaging in notetaking practice. Students in this group practiced writing notes and reviewing them for the videotaped lectures on assertion and irrational thinking.

**Posttraining**

The posttraining session was scheduled for a period of 45 minutes. Students were given their numbered package containing posttraining material. Students in the Example Only group were no longer provided with the guidelines for writing examples. Students were told that they would listen to the last section of the videotaped lecture on creativity, which included three parts: innovative, emergentative, and school creativity. Participants were told to write notes and review them by using the notetaking strategies that they had been taught. Steps that the students were expected to follow were displayed on a chart and were explained to them. The steps were then carried out sequentially and are explained next.

Students listened to a four-minute segment on innovative creativity while writing notes. They then reviewed their notes for a period of four minutes. They wrote notes again while listening to the four-minute segment on emergentative creativity and reviewed their notes for a
period of four minutes. Finally, they wrote notes on school creativity which was three minutes in duration; notetaking was again followed by a four-minute review period. Notes were collected from the students, and they completed the 10-minute cued-recall test on creativity. Finally, students completed the evaluation form. The recall tests and evaluation sheets were collected. Participants were informed that the writer would return the following week to find out how much they could remember about the types of creativity.

Retention Testing

The author returned to the class one week following posttraining for the final session. Students completed the same 10-minute cued-recall test that was administered during the posttraining session. Completed tests were collected and students were thanked for their cooperation and participation in the research project.
CHAPTER 4
Results

The results of the study are presented in three parts. First, the results of analyses related to each research hypothesis are reported. Second, correlations are reported that show the relationship between ideas noted and recalled by students. These correlations are presented across the four groups combined and also for each group separately. Third, the observational data taken during the study are presented.

Group differences

Pretest differences. Separate 2 X 2 analyses of variance were conducted to determine whether pretest differences existed among the four notetaking groups on the percentage of ideas recorded in notes and later recalled by students. One factor in the 2 X 2 design was Generative Strategy (Example or No Example) and the other factor was Method of Notetaking (Matrix or Conventional). In addition, separate chi-square tests were conducted to determine if the frequency of reported notetaking strategies differed among the groups prior to training.

Results of the two-way ANOVA on ideas noted revealed a main effect for Generative Strategy, $F(1, 152) = 4.80$, $p < .05$ (see Table 1). Students in the Example group, combined over the two methods of notetaking, recorded more ideas in their notes than did students in the No Example group (grand
Table 1
Two-Way Analysis of Variance on Ideas Noted at Pretest

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>288.10</td>
<td>1</td>
<td>288.10</td>
<td>4.80</td>
<td>.030</td>
</tr>
<tr>
<td>Method</td>
<td>672.92</td>
<td>1</td>
<td>672.92</td>
<td>11.22</td>
<td>.001</td>
</tr>
<tr>
<td>Example X Method</td>
<td>118.56</td>
<td>1</td>
<td>118.56</td>
<td>1.97</td>
<td>.162</td>
</tr>
<tr>
<td>Error</td>
<td>9112.10</td>
<td>152</td>
<td>59.94</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
means = 17.59, 14.87, respectively). There was also a main effect for Method of Notetaking, $F(1, 152) = 11.22$, $p < .001$. Learners in the Matrix group, combined over the two generative strategies, recorded more ideas than did those in the Conventional group (grand means = 18.31, 14.15, respectively). The interaction between Generative Strategy and Method of Notetaking was not significant, $F(1, 152) = 1.97$, $p > .05$. Means and standard deviations for ideas noted appear in Table 2.

Results of the two-way ANOVA on ideas recalled indicated that the main effect for Generative Strategy was not significant, $F(1, 152) = 2.25$, $p > .05$ (see Table 3). The main effect for Method of Notetaking was not significant, $F(1, 152) = 3.06$, $p > .05$, nor was the interaction between Generative Strategy and Method of Notetaking, $F(1, 152) = .17$, $p > .05$.

The chi-square tests for strategy use revealed that all notetaking groups were statistically similar on the frequency of their self-reports regarding: (a) how often they usually took notes, $\chi^2(12, N = 156) = 7.03$, $p > .05$; (b) how they wrote notes, $\chi^2(9, N = 156) = 7.47$, $p > .05$; (c) what they wrote in their notes, $\chi^2(18, N = 156) = 16.45$, $p > .05$; and (d) how they usually reviewed their notes, $\chi^2(18, N = 156) = 16.00$, $p > .05$.

**Posttest differences.** Separate 2 X 2 ANCOVAs were conducted to determine the effects of the Generative
Table 2

Adjusted Means and Standard Deviations for the Percentage of Ideas Noted and Recalled by Experimental Group at Pretest, Posttest, and Retention

<table>
<thead>
<tr>
<th>Measures</th>
<th>Ex</th>
<th>Ex/Mat</th>
<th>Mat</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>16.38</td>
<td>18.79</td>
<td>17.82</td>
<td>11.92</td>
</tr>
<tr>
<td></td>
<td>8.49</td>
<td>7.00</td>
<td>7.04</td>
<td>8.30</td>
</tr>
<tr>
<td>Cued-Recall</td>
<td>7.87</td>
<td>8.97</td>
<td>8.07</td>
<td>6.28</td>
</tr>
<tr>
<td></td>
<td>5.49</td>
<td>5.46</td>
<td>4.70</td>
<td>4.97</td>
</tr>
<tr>
<td>Posttest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>29.39</td>
<td>38.23</td>
<td>39.67</td>
<td>25.29</td>
</tr>
<tr>
<td></td>
<td>14.43</td>
<td>10.73</td>
<td>8.55</td>
<td>11.89</td>
</tr>
<tr>
<td>Cued-Recall</td>
<td>10.00</td>
<td>15.59</td>
<td>20.14</td>
<td>9.00</td>
</tr>
<tr>
<td></td>
<td>7.68</td>
<td>8.19</td>
<td>7.38</td>
<td>7.05</td>
</tr>
<tr>
<td>Retention</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cued-Recall</td>
<td>3.39</td>
<td>5.45</td>
<td>6.22</td>
<td>1.90</td>
</tr>
<tr>
<td></td>
<td>3.94</td>
<td>4.68</td>
<td>4.74</td>
<td>2.41</td>
</tr>
</tbody>
</table>

Note. Ex = Example Only; Ex/Mat = Example-Matrix; Mat = Matrix Only; Con = Conventional. <sup>a</sup>n = 39 for each group. <sup>b</sup>Unadjusted means.
Table 3
Two-Way Analysis of Variance on Cued-Recall at Pretest

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>60.31</td>
<td>1</td>
<td>60.31</td>
<td>2.25</td>
<td>.135</td>
</tr>
<tr>
<td>Method</td>
<td>81.85</td>
<td>1</td>
<td>81.85</td>
<td>3.06</td>
<td>.082</td>
</tr>
<tr>
<td>Example X Method</td>
<td>4.67</td>
<td>1</td>
<td>4.67</td>
<td>0.17</td>
<td>.676</td>
</tr>
<tr>
<td>Error</td>
<td>4064.00</td>
<td>152</td>
<td>26.73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Strategy relative to the Method of Notetaking on the percentage of ideas noted and recalled by students. Additionally, chi-square tests were performed on the attitudes of students toward their respective notetaking strategy.

As a result of the differences among notetaking groups on the percentage of ideas noted at pretest, analysis of covariance was conducted on ideas noted at posttest (adjusted for pretest performance). Prior to the analysis, however, the homogeneity-of-regression slope assumption required for ANCOVA was tested. Analysis of variance on ideas noted at posttest revealed a nonsignificant interaction between the treatment (i.e., notetaking group) and the covariate (i.e., ideas noted at pretest), $F(3, 148) = 1.94, p > .05$.

Results of the subsequent two-way ANCOVA on ideas noted indicated that the main effect for Generative Strategy was not statistically significant, $F(1, 151) = .68, p > .05$ (see Table 4). There was, however, a main effect for the Method of Notetaking, $F(1, 151) = 49.95, p < .05$. Students in the Matrix condition, combined over the two generative strategies, recorded more ideas than those who wrote notes Conventionally (grand means = 38.95, 27.34, respectively). The interaction between Generative Strategy and Method of Notetaking was not significant, $F(1, 151) = 3.00, p > .05$.

A two-way ANCOVA for cued-recall was conducted with
Table 4

Two-Way Analysis of Covariance on Ideas Noted at Posttest

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>67.04</td>
<td>1</td>
<td>67.04</td>
<td>0.68</td>
<td>.409</td>
</tr>
<tr>
<td>Method</td>
<td>4895.31</td>
<td>1</td>
<td>4895.31</td>
<td>49.95</td>
<td>.000</td>
</tr>
<tr>
<td>Example X Method</td>
<td>294.64</td>
<td>1</td>
<td>294.64</td>
<td>3.00</td>
<td>.085</td>
</tr>
<tr>
<td>Prenote</td>
<td>5663.11</td>
<td>1</td>
<td>5663.11</td>
<td>57.79</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>14796.42</td>
<td>151</td>
<td>97.99</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
pretest performance as the covariate after testing the homogeneity-of-regression slope assumption required for ANCOVA. Analysis of variance on ideas recalled at posttest revealed a nonsignificant interaction between the treatment (i.e., notetaking group) and the covariate (i.e., ideas recalled at pretest), \( F(3, 148) = .80, p > .05 \).

Results of the subsequent ANCOVA revealed that the main effect for Generative Strategy was not significant statistically, \( F(1, 151) = 2.50, p > .05 \) (see Table 5). However, there was a main effect for the Method of Notetaking, \( F(1, 151) = 55.64, p < .05 \). Matrix notetaking, combined over the two generative strategies, led to significantly greater recall by students than did Conventional notetaking (grand means = 17.86, 9.50, respectively).

Although there was a main effect on the overall difference between Matrix and Conventional notetaking groups on cued-recall, there was a significant interaction between Generative Strategy and Method of Notetaking, \( F(1, 151) = 6.25, p < .05 \). Therefore, separate tests of simple effects were conducted to determine the difference between the Matrix and Conventional notetaking groups for: (a) the Example review group, and for (b) the Conventional review group. Results from these tests indicate that there are significant differences in the percentage of ideas recalled between Matrix and Conventional notetakers both in: (a)
Table 5

Two-Way Analysis of Covariance on Cued-Recall at Posttest

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
<td>120.49</td>
<td>1</td>
<td>120.49</td>
<td>2.50</td>
<td>.115</td>
</tr>
<tr>
<td>Method</td>
<td>2672.31</td>
<td>1</td>
<td>2672.31</td>
<td>55.64</td>
<td>.000</td>
</tr>
<tr>
<td>Example X Method</td>
<td>300.24</td>
<td>1</td>
<td>300.24</td>
<td>6.25</td>
<td>.013</td>
</tr>
<tr>
<td>Prerecall</td>
<td>1509.47</td>
<td>1</td>
<td>1509.47</td>
<td>31.43</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>7251.80</td>
<td>151</td>
<td>48.02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
utilizing the Example review strategy, $F(1, 152) = 13.24, p < .001$; and (b) in using Conventional review, $F(1, 152) = 50.60, p < .001$. As shown in Figure 1, recall is significantly better for Matrix notetakers than for Conventional in the Example review condition. Similarly, Matrix notetakers outperformed Conventional notetakers in the Conventional review condition. These two simple effects support the overall main effect of the Method of Notetaking on cued-recall performance.

An alternative explanation of the significant interaction is that the effect of the Generative Strategy is dependent upon the level of Notetaking Method. A test of simple effects indicates a significant difference in cued-recall performance between Example and Conventional reviewers utilizing the Matrix Notetaking Method, $F(1, 152) = 5.41, p < .05$. However, the difference between the Example and Conventional reviewers is not significant for the Conventional Method of Notetaking, $F(1, 152) = 1.31, p > .05$. As shown in Figure 2, recall performance is actually lower for Example reviewers than Conventional in the Matrix notetaking condition; however, performance is similar for both Example and Conventional reviewers in the Conventional notetaking condition.

The chi-square test for strategy use revealed significant differences among the groups, $\chi^2(3, N = 156) = 10.81, p < .05$. The standardized residual (Hinkle, Wiersma,
Percentage of Ideas Recalled at Post Test as a Function of Generative Strategy
Figure 2

Percentage of Ideas Recalled at Post Test as a Function of Notetaking Method
& Jurs, 1994) for the Matrix condition indicated that the Matrix Strategy was a major contributor to the significant chi-square value (residual = -2.16). In comparing the observed with expected frequencies, fewer students than expected reported that they did not use the Matrix notetaking strategy. The chi-square tests for attitude revealed that the notetaking groups were homogenous regarding their responses to: (a) whether they would have used the strategy if it had not been taught, $\chi^2(3, N = 156) = 3.24, p > .05$; and (b) whether or not they plan to use the strategy in the future, $\chi^2(3, N = 156) = .90, p > .05$.

**Retention test differences.** A two-way ANCOVA for retention was conducted with pretest performance as the covariate after testing the homogeneity-of-regression slope assumption required for ANCOVA. Analysis of variance on ideas recalled at retention revealed a nonsignificant interaction between the treatment (i.e., notetaking group) and the covariate (i.e., ideas recalled at pretest), $F(3, 148) = 1.27, p > .05$.

The two-way analysis of covariance for ideas recalled indicated that the main effect for the Generative Strategy was not significant, $F(1, 151) = .35, p > .05$ (see Table 6). There was a main effect for the Method of Notetaking, $F(1, 151) = 27.96, p < .05$. Students in the Matrix group, combined over the two generative strategies, recalled more ideas than those who wrote notes Conventionally (grand means
Table 6
Two-Way Analysis of Covariance on Cued-Recall at Retention

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sum of Squares</th>
<th>DF</th>
<th>Mean Square</th>
<th>F</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example</td>
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<td>1</td>
<td>4.98</td>
<td>.35</td>
<td>.550</td>
</tr>
<tr>
<td>Method</td>
<td>387.91</td>
<td>1</td>
<td>387.91</td>
<td>27.96</td>
<td>.000</td>
</tr>
<tr>
<td>Example X Method</td>
<td>49.94</td>
<td>1</td>
<td>49.94</td>
<td>3.60</td>
<td>.060</td>
</tr>
<tr>
<td>Prerecall</td>
<td>405.37</td>
<td>1</td>
<td>405.37</td>
<td>29.22</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>2094.44</td>
<td>151</td>
<td>13.87</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The interaction between Generative Strategy and Method of notetaking was not significant, $F(1, 151) = 3.60$, $p > .05$.

**Correlational Analyses**

**Across groups.** As shown in Table 7, all correlations between the variables of note quality and recall are significant, statistically ($p < .001$). Coefficients for the relationship between note quality and recall are moderate and positive at pretest and across the three training sessions. There is a high positive correlation between these two variables, however, at posttest ($r = .73$, $p < .001$) (Hinkle et al., 1994). More specifically, note quality at posttest accounts for 53% of the variability in cued-recall. Prior to training, however, note quality accounts for 29% of the variability in cued-recall, whereas 71% is related to other factors.

**Within groups.** An inspection of Table 7 indicates that correlations between note quality and recall at pretest are moderate for the Example and Conventional groups, but low for the Example-Matrix and Matrix groups. At posttest, these correlations are moderate for the Example-Matrix, Matrix, and Conventional groups, but high for the Example group (Hinkle et al., 1994). Note quality accounts for 27% of the variability in cued-recall at pretest, for the Example group, whereas at posttest, it is related to 60% of the variability.
Table 7

Correlation Coefficients for the Relationship Between the Variables of Note Quality and Cued-Recall by Session

<table>
<thead>
<tr>
<th>Session</th>
<th>Ex</th>
<th>Ex/Mat</th>
<th>Mat</th>
<th>Con</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretest</td>
<td>.54** (.29)*</td>
<td>.52* (.27)</td>
<td>.42* (.17)</td>
<td>.48* (.23)</td>
</tr>
<tr>
<td>Posttest</td>
<td>.73** (.53)</td>
<td>.78** (.60)</td>
<td>.55** (.30)</td>
<td>.64** (.40)</td>
</tr>
<tr>
<td>Training1</td>
<td>.64** (.40)</td>
<td>.82** (.67)</td>
<td>.22 (.04)</td>
<td>.59** (.34)</td>
</tr>
<tr>
<td>Training2</td>
<td>.66** (.43)</td>
<td>.86** (.73)</td>
<td>.30 (.09)</td>
<td>.25 (.06)</td>
</tr>
<tr>
<td>Training3</td>
<td>.65** (.42)</td>
<td>.77** (.59)</td>
<td>.72** (.51)</td>
<td>.49* (.24)</td>
</tr>
<tr>
<td>n</td>
<td>111</td>
<td>21</td>
<td>31</td>
<td>33</td>
</tr>
</tbody>
</table>

Note. Ex = Example Only; Ex/Mat = Example-Matrix; Mat = Matrix Only; Con = Conventional.

*a r².  b n is down from 156 to 111 because students met the selection criterion of 83% mastery for strategy utilization without attending all three training sessions.

*p<.05.  **p<.001.
As shown in Table 7, high correlations exist between note quality and recall for each of the three training sessions for the Example group, \( r = .82, p < .001 \) (first session); \( r = .86, p < .001 \) (second session); \( r = .77, p < .001 \) (third session). For the Example-Matrix group, the correlations between these variables appear low and nonsignificant for the first two training sessions, \( r = .22, p > .05 \) (first session); \( r = .30, p > .05 \) (second session). Yet the correlation for this group is high for the third training session, \( r = .72, p < .001 \). Correlations between ideas noted and recalled for the first training session are moderate for the Matrix group, \( r = .59, p < .001 \), and high for the Conventional group, \( r = .79, p < .001 \). However, correlations for these two groups are low for the last two training sessions (see Table 7) (Hinkle et al., 1994).

**Observational Data**

Research assistants were asked to comment on: (a) the behaviour of students with regard to the task and (b) the clarity of instruction for the notetaking strategies that were taught. Field notes indicate that the class members were generally on task, well focused, well organized, and attentive, with the exception of a few students. Comments reveal that the students, on the whole, demonstrated a good grasp of the strategies that were taught. For instance, it was observed that most students in the Example condition generated a wide variety of examples and then checked that
these examples matched the concepts recorded in their notes.

Field notes indicate that the notetaking strategies were taught effectively. Comments indicate that the instruction was clear, explanatory, directive, and concise. Notes reveal that: (a) the teaching methods were organized; (b) effective overviews were provided; and (c) the lessons flowed smoothly. It was observed that classroom management was maintained effectively. However, it was noted that the large class sizes at one school presented a challenge. Particular difficulties involved: (a) visibility of the video for students who were seated along the sides of the classroom; (b) distributing materials to such large classes; and (c) classroom management for one instructor with such large class sizes.

Summary

In summary, the data indicate that the instruction for notetaking strategies was clear and that the behaviour of students was generally on task. On this basis, the overall results indicate that the Matrix strategy is more effective than Conventional for helping students to write more extensive notes and to recall more information from the lecture immediately and one-week later. Moreover, the interaction between the Method of Notetaking and Generative Strategy for immediate recall supports the benefit of the Matrix technique. Matrix notetakers fared better than Conventional for the immediate recall of lecture material.
whether they use the Example or Conventional method of reviewing their notes. Another view is that recall is better for students who review their notes Conventionally than for those who write examples for the Matrix Method of Notetaking. An additional point to highlight is the favourable attitude of students toward utilizing the Matrix strategy. With regard to the Generative strategy, writing examples for review did not help students to write more extensive notes nor to recall lecture information immediately or one week later.

All correlations between note quality and recall are positive both across and within the four groups. The correlations across groups are moderate over the pretest and three training sessions, but high at posttest. Worthy of particular mention is the high correlation between the note quality and recall variables for the Example group at posttest and across training. Also of interest are the low and nonsignificant correlations for the Example-Matrix group for both the first and second training sessions (Hinkle et al., 1994).
Chapter 5

Discussion

The current study revealed several interesting findings that are discussed in this chapter. The chapter begins with a summary of the main results and a comparison with the relevant existing literature. Theoretical and practical implications of the findings are discussed and, finally, suggestions for further research are outlined.

The present research examined four hypotheses. It was predicted that: (a) Example-Matrix notetakers would record more ideas in their notes than either Example or Matrix notetakers; (b) Example-Matrix notetakers would achieve higher scores on the cued-recall test than either Example or Matrix notetakers; (c) the Example strategy on its own would be beneficial; and (d) the percentage of ideas recorded in students' notes would be related to the percentage recalled by them.

Results of the present study confirm the prediction that note quality and test performance are related. Correlations between ideas noted and recalled at posttest are significant both across the four notetaking groups as well as within each group. The extent of note quality, that is, the number of idea units noted across the four groups, accounts for 53% of the variability in cued-recall performance. This finding is consistent with other findings of Kiewra and Fletcher (1984) which indicate that the number
of test-related ideas recorded by students accounts for 52% of the variability in immediate test performance. Additional research has confirmed correlations between ideas noted and achievement (Kiewra, Benton, & Lewis, 1987) and between ideas noted and writing essays (Benton et al., 1993). The number of ideas noted by students was reported to be correlated with essay coherence and with the number of ideas and words written in students’ essays (Benton et al., 1993).

The anticipated advantage of the Example-Matrix strategy over the Example Only or Matrix Only strategy for ideas noted and recalled by students was not found in the current study. Although the unique benefits of the Example-Matrix strategy were not realized, the Matrix component was found to be beneficial for ideas noted. Immediate and delayed recall scores were also improved for Matrix notetakers.

Facilitative effects of the Matrix strategy on ideas noted and recalled are consistent with those reported in the literature. In their investigation into the utility of various notetaking techniques, Kiewra, DuBois et al. (1991) found that more ideas were recorded in Matrix ($M = 47.19\%$) and Linear ($M = 46.61\%$) notes than in Conventional ($M = 31.65\%$). Using the videotape on Creativity borrowed from Kiewra, DuBois et al., present findings show that Matrix notetakers ($M = 38.95\%$), combined across the Example and No
Example groups, recorded more ideas in their notes than did Conventional notetakers (M = 27.34%).

Prior research has established that the Matrix strategy is useful for the recall of lecture ideas by students (Kiewra et al., 1988; Kiewra, DuBois, et al., 1991). Kiewra, DuBois, et al. found that cued-recall was greater for the recording, review (or both) of Matrix notes (M = 18.18%) than for Conventional notes (M = 12.16%). Kiewra et al. reported that providing students with Matrix (M = 17.20%) or Outline (M = 17.42%) notes for review facilitated their performance on cued-recall more than providing them with a complete text (M = 11.49%) of the lecture. Present findings confirmed the superiority of the Matrix strategy (M = 17.86%) for cued-recall, across the Example and No Example conditions, relative to Conventional notetaking (M = 9.50%).

The superiority of the Matrix strategy in comparison with Conventional notetaking in this study is in line with levels of processing along a generative continuum. A greater number of internal connections would be expected to be established by learners using the Matrix strategy than with Conventional notetaking. However, in keeping with this levels of processing paradigm, more connections are expected for learners using the Example-Matrix strategy, thereby enhancing their cued-recall performance, than for those using the Matrix technique alone. Instead, the advantage in this study favored the Matrix Only strategy over the
Example-Matrix technique. This finding seems contradictory to the levels of processing hypothesis and is explained next with a focus on the generation effect, encoding specificity, and transfer appropriate processing.

One explanation for the contradictory finding is that the generation effect is not as robust as implied by findings of Slamecka and Graf (1978). Begg et al. (1991) conducted experiments to determine whether memorability is enhanced by generating words from fragments (e.g., mai_en, irr_tat_on) as opposed to reading them in their complete form (e.g., maiden, irritation) when encoding is controlled. Begg et al. matched processing requirements underlying the generation and read conditions by instructing subjects in both groups to: (a) pronounce the target word, (b) imagine the target word, and (c) rate each word for memorability. These instructions were aimed at ensuring that the read condition involved a discriminative encoding process similar to generation.

Following the initial presentation, students were given recognition and cued-recall tests to measure their ability to discriminate between the studied words and the distractors. Yes-no recognition tests required students to respond with "yes" to studied items and "no" to distractors unrelated to the target words. A two-alternative forced choice test required students to choose the studied word rather than distractors that were similar to the target
words either orthographically or semantically. Cued-recall tests required students to provide the response word (e.g., horse) in a categorically related word pair (e.g., tiger-horse) or fragment (e.g., tiger-h_ rse), upon presentation of the cue (e.g., tiger); and students to provide the response word with the cue augmented by a category label (e.g., animal: tiger-horse).

Efforts to control processing between the generate and read conditions resulted in findings that favor generating versus reading for pronouncing words but not for imagining them on tests of both recognition and cued-recall. Additional findings reveal higher ratings for the memorability of encoded items for pure generators than pure readers and for generated items than read items on lists mixing both complete words and word fragments. However, the performance on tests of word recognition and cued-recall revealed no generation effect.

Although it makes sense to expect that a greater number of connections are formed by learners utilizing the Example-Matrix strategy than the Matrix technique in the present study, two points are worthy of consideration. First, differences possibly exist between the Example-Matrix and Matrix strategy in facilitating the discriminative encoding of main ideas presented in lecture as opposed to nonrelevant information. Second, the cued-recall test perhaps measures cognitive processes that underlie Matrix notetaking better.
than the Example-Matrix method. This leads to a discussion of ideas about the encoding specificity principle developed by Tulving (1983) to further explain the apparently contradictory finding in the present research.

The expectation that recall is facilitated by learners building connections via highly generative processing appears to be outweighed by the encoding specificity principle. This principle is based on Tulving's (1983) assertion that cues at retrieval help learners to access to-be-remembered material insofar as these cues are encoded, initially, in conjunction with the new information (Crowder, 1993). The encoding specificity principle originates from research by Tulving and Pearlstone (1966) indicating that category names on tests of cued-recall better facilitate the retrieval of information belonging to semantic categories relative to tests of free-recall (Roediger et al., 1989).

Empirical evidence supporting the encoding specificity principle fits into the encoding/retrieval paradigm based on the ideas of Tulving (1983). This paradigm holds that conditions between retrieval and encoding that are matched enhance the recollection of information stored in memory better than conditions that are less well matched (Perlmutter, 1988; Roediger et al., 1989). Although highly generative activity is expected to facilitate recall, researchers such as Morris, Bransford, and Franks (1977) have established that differences between encoding and
retrieval conditions can eliminate or even reverse the levels of processing effect. Roediger et al. (1989) report findings of Morris et al. that contradict the levels of processing effect but explicate the encoding/retrieval paradigm.

Support for the levels of processing effect would be reflected by findings that reveal the superiority of deep semantic processing relative to phonemic processing, regardless of the retrieval condition. For example, Morris et al. (1977) found that performance on a semantic-based test at retrieval was better for words encoded semantically versus phonemically. However, performance on a rhyme recognition test was superior for words encoded phonemically than semantically, which is in opposition to the levels of processing effect. The reversal of the levels of processing effect, explained by the encoding specificity principle, highlights the importance of matching the processing conditions at encoding and retrieval to benefit the recollection of encoded material (Roediger et al., 1989).

Benton et al. (1993) examined the effects of notetaking and review on writing essays, and explained their findings in the context of the encoding specificity principle. These researchers found that essays were longer, more cohesive, and more coherent for students reviewing personal notes while writing the essay, immediately following notetaking, than listeners writing the essay without notes.
Furthermore, no benefits were found for the essay task when listeners were provided with notes to review while writing the essay. Benton et al. explained that the review of personal notes during essay writing is consistent with encoding ideas during personal notetaking which is in line with the encoding specificity principle.

In the present research, the conditions at encoding and retrieval are most closely matched for the Matrix strategy. Category names for the types (e.g., Innovative, Emergentative, School) and dimensions (e.g., definition, motivation, myths) of creativity on the Matrix sheet at encoding reappear on the cued-recall test at retrieval. Advantages of the Matrix strategy in the present study are consistent with findings in the notetaking literature showing benefits of Matrix notetaking for cued-recall performance (Kiewra, DuBois et al., 1991) as opposed to free-recall (Kiewra et al., 1989). Without cues on the free-recall test in the study conducted by Kiewra et al. (1989), accessibility was not enhanced for ideas on the Matrix sheet though the ideas may have been encoded initially during notetaking.

Memorial benefits were not found for the Example strategy in the present study. The Example strategy is content-driven as opposed to category-driven. The process of writing examples and checking them, for instance, focuses on the presented idea units rather than on linking the idea
units with the category or cue. For instance, when writing an example for the topic of innovative creativity at posttest, learners focused on the idea units for the dimensions of innovative creativity without linking these ideas to the row headings or cues (see Appendix A). An example of idea units for innovative creativity is as follows: "Ability to significantly change a major process, product, or school of thought...Stems from dissatisfaction..." (Kiewra, 1989, pp. 154, 155). It would have been beneficial for students to link these presented idea units explicitly with the category cues of "definition", and "motivation", respectively, during the process of writing an example for innovative creativity. Without highlighting the cues at encoding, cues at retrieval do not match encoding conditions for the Example strategy and therefore do not aid in accessing target information encoded during notetaking (Crowder, 1993). This absence of cues at encoding explains why the Example condition in the present study was no greater than Conventional notetaking for memorability.

A final explanation offered for the unanticipated findings in the present research is that the cued-recall test perhaps limited the amount of information transferred from encoding during notetaking. This explanation refers to transfer-appropriate processing which is the notion that encoding promotes good test performance to the extent that
the test facilitates the transfer of information encoded during the lecture (Roediger et al., 1989). Assumptions underlying transfer-appropriate processing hold that separate measures of retention at retrieval require different modes of processing during study. Dissociations between measures of retention and processing during encoding serve to explain seemingly contradictory findings in the notetaking literature as well as in the present research.

Roediger et al. (1989) suggested that transfer-appropriate procedures aid in explaining the dissociations between explicit and implicit measures of retention. Explicit measures refer to tests with instructions requiring students to recollect recent experiences directly. Examples are tests of recall or word recognition. Implicit memory instructions disguise the transfer of verbal information from prior experience by not requiring students to recollect events directly. Words are presented for students to remember, then retention is assessed, indirectly (e.g., by requiring students to produce the first word that comes to mind in response to the information provided). For the word fragment identification test, students are instructed to produce a complete word when some letters of the word are deleted and replaced by blanks (e.g., R_FL_). For the word stem completion test, students are instructed to complete the word stem from the first three letters provided (e.g., RIF_ _) (Roediger et al., 1989).
The distinction between explicit and implicit measures of retention is established in the literature (Roediger et al., 1989). Findings of Warrington and Weiskrantz (1970, Experiment 2) cited by Roediger et al. (1989), indicate that amnesics and normals performed similarly on implicit tests such as word stem completion and word fragment identification but retention was poorer for amnesics on explicit tests such as free-recall and recognition. These results indicate that retention of verbal information is intact for amnesics on implicit tests, permitting the transfer of information encoded during prior study but not on explicit tasks. Although findings based on the brain-damaged population may not generalize to the normal population, they provide insights into procedures of memory involving implicit and explicit modes of processing (Roediger et al., 1989).

Dissociations between measures of retention possibly serve to explain findings of Peper and Mayer (1986) in the notetaking literature. The videotaped lecture was on the topic of how car engines work. Encoded information via notetaking or listening to the lecture was assessed by four measures: syntactic recognition, semantic recognition, fact retention, and problem-solving. The former three tests are explicit, requiring the direct recollection of information noted, and the problem-solving test is implicit, requiring students to produce solutions to problems posed (Roediger et
al., 1989). Results of two experiments by Peper and Mayer (1986) reveal that notetakers perform better on problem-solving tasks than listeners but worse on tests measuring the retention of factual information. The implicit processing required by the problem-solving test appears to have enhanced the transfer of information about car engines better than the more explicit factual-based tests.

Results of Graf, Squire, and Mandler (1984) cited by Roediger et al. (1989), highlight the significance of test instructions or cognitive set for increasing repetition priming. Repetition priming refers to the percentage of words completed correctly due to prior study. Graf et al. (1984) presented the same three-letter word stems to amnesics and controls for conditions of both explicit and implicit memory instructions. The explicit memory instructions required students to use the three-letter stems as cues to recall the words in prior study. The implicit memory instructions required students to produce a word in response to the provided stem consisting of the first three letters.

Findings reveal similar performance for amnesics and controls when given implicit instructions. However, the level of priming is worse for amnesics than normals when given explicit instructions. With the word stems held constant in this experiment, findings point to dissociations between explicit and implicit memory instructions. Implicit
memory instructions facilitate the transfer of verbal information from encoding to testing for both amnesics and normals, whereas explicit memory instructions do not enhance repetition priming for amnesics. In particular, instructions that direct students to produce words help them to access the stored information whereas an awareness of the recall task via explicit instructions seems to limit the transfer of information for amnesics.

Findings of Kiewra and Fletcher (1984) are interesting when revisited in the context of implicit versus explicit memory instructions. These researchers provided differential notetaking instructions directing students to record only factual, conceptual, relational, or typical ideas during notetaking in preparation for an exam that would test only ideas specific to their prescribed mode of notetaking. The 19-item test consisted of explicit memory instructions for the nine factual items, and implicit memory instructions for the five conceptual items, and five relational items (Roediger et al., 1989). Instructions for the factual items required students to state facts from the lecture, for conceptual items to provide summaries of recorded information, and for relational items to apply the presented ideas to new situations.

Results indicate that students recorded a similar number of conceptual notes despite the differential instructions. It is reasonable to expect the implicit
conceptual items to enhance the transfer of conceptual ideas contained in notes. In contrast, however, results reveal higher scores on both factual and relational items than on conceptual. Perhaps the implicit instructions for the conceptual test items were overruled by the cognitive set established by differential instructions at encoding. Specifically, explicit memory instructions for factual items elicited the transfer of information encoded by factual notetakers, and implicit instructions for relational items enhanced access to ideas encoded by relational notetakers despite the conceptual ideas in notes.

Explicit memory instructions on the cued-recall test in the present study fostered the transfer of ideas encoded by Matrix notetaking (Roediger et al., 1989). Instructions for cued-recall required students to use the category names to recollect directly the lecture ideas pertaining to these cues. Instructions for Matrix notetaking required students to use the category names for recording pertinent ideas from the lecture. The procedural overlap of instructions at retrieval and encoding appears to be high, therefore facilitating the transfer of encoded information to the cued-recall test. Moreover, the positive attitude of the students toward Matrix notetaking perhaps enhanced the transfer of information to aid performance on the cued-recall test (Roediger et al., 1989).

Dissociations between explicit memory instructions on
the cued-recall test and instructions for the Example strategy possibly limit the transfer of information encoded. Explicit memory instructions for the cued-recall test require students to directly recollect ideas from the lecture whereas the Example strategy requires students to produce examples in response to the ideas contained in their notes. An implicit test, making no reference to ideas noted in prior study, would possibly aid in the transfer of information better than the cued-recall test with explicit memory instructions.

Findings of Barnett, DiVesta, and Rogozinski (1981) are consistent with those in the present study which point to the importance of matching the processing at retrieval with elaborations during encoding. Barnett et al. (1981) investigated the advantages of elaborations as opposed to review on items constructed on the basis of the lecture presentation, peer notes, or one's own notes. Students in the Elaboration condition were instructed to extend the new ideas by linking them to prior knowledge whereas those in Review were instructed to write detailed information about the key points of the lecture.

Findings favored the Review condition over Elaboration for items taken directly from the lecture presentation. These items failed to foster the transfer of personal elaborations encoded during the review session. Rather, they facilitated the transfer of detailed key points encoded
during the study session. Advantages were found for one’s own items, across conditions of Review and Elaboration, in comparison with those constructed from the notes of peers or from the lecture. The advantage for answering items constructed from one’s personal notes shows that these items foster the transfer of information encoded during notetaking.

In summary, the generation effect on its own is not adequate in explaining the pattern of findings in the present study. Results of experiments conducted by Begg et al. (1991) point to the importance of examining the underlying processes involved in tasks such as reading and generating that are being compared for their relative benefits. They found that when the processing conditions were matched for the read and generate conditions, advantages favoring the generation effect were not robust which is consistent with earlier findings of Slamecka and Katsaiti (1987). Encoding specificity points to the importance of matching the underlying processes for the conditions of encoding and retrieval. Transfer-appropriate processing, being more general than encoding specificity, highlights the significance of examining the extent to which measures of retention foster the transfer of information encoded (Roediger et al., 1989).

In light of integrating the present findings with what is known about the generation effect, the encoding
specificity principle, and transfer-appropriate procedures, the discussion now turns to theoretical implications of the present research for the notetaking literature.

Theoretical Implications

Present findings highlight the importance of revising existing theoretical perspectives in the notetaking literature (e.g., Kiewra, 1988). The transfer-appropriate processing theory, incorporating encoding specificity, provides a more comprehensive basis upon which to formulate research hypotheses than does the less robust generative view. The main theoretical thrust in the notetaking literature, however, has stemmed from generative views in isolation.

Peper and Mayer (1978, 1986) assert that notetaking is a generative activity linking new information with prior knowledge. In contrast, Kiewra and his associates (Frank et al., 1989; Kiewra, DuBois et al., 1991) theorize that generative processing or building internal and external connections is more likely to occur during review than notetaking due to the limited capacity for processing and diverted attention during notetaking. King (1992a) has studied the utility of generative strategies for encoding lecture material during review. The emphasis to date has been on the benefits of generation during encoding or review as opposed to detailing the elements of generative processing.
Findings of the current research indicate that it is not enough to formulate hypotheses based on the levels of processing notion in isolation (Begg et al., 1991; Slamecka & Katsaiti, 1987). Highly generative processing via Example-Matrix notetaking aimed at building connections by learners did not facilitate greater recall of to-be-remembered material relative to low generative activity such as Conventional notetaking (Kiewra, 1991; Kiewra, DuBois et al., 1991; Kiewra & Fletcher, 1984). These findings point to the importance of matching the conditions of encoding and retrieval to facilitate the transfer of encoded material to the test (Roediger et al., 1989).

The work of Kiewra (1991) is in line with these larger theoretical notions emphasizing the importance of matching the criterion measure with the mode of processing during notetaking. However, he limits his discussion to considerations of matching factual learning with factual based tests, internal connections with synthesis tests, and external connections with application tests. Rather than emphasizing whether or not a specific type of test matches the cognitive processes required for task completion, it is reasonable to shift the focus toward specifying the retrieval conditions.

Generative processing falls short of the requirement that theories of cognitive structure must specify a set of conditions operating during retrieval (Roediger et al.,
Findings of the current research show that it is useful to determine: (a) the underlying cognitive processes involved in measures of retention such as the cued-recall test, (b) whether explicit memory instructions for measures such as cued-recall foster the transfer of encoded material, and (c) whether category names on tests like cued-recall are included in the instructions for techniques such as the Matrix strategy and Example strategy.

Roediger et al. (1989) cited findings of Tulving and Pearlstone (1966) indicating that advantages of cued-recall as opposed to free recall exceed two hundred percent in some of their experiments. This advantage of cued-recall illustrates the ramifications of specifying the retrieval conditions in order to enhance students' ability to later access the to-be-remembered material available in memory. In the present study, the retrieval conditions served to benefit performance on the cued-recall test for the Matrix Only strategy; however, access to information available in memory was limited under conditions operating during cued-recall for students utilizing the Example strategy.

Clarity on the theoretical implications of the present research leads to a discussion of the practical implications.

Practical Implications

Interaction effects for cued-recall at posttest in the present study inform instructional practice of how encoding
during notetaking and review are improved by the use of instructional aids (Kiewra, 1991). Interaction effects show that: (a) encoding is enhanced by the Matrix Strategy, and (b) review is not improved by the Example strategy on its own but is benefitted only when the Example technique is combined with the Matrix strategy. Specifically, cued-recall is 55% worse for Conventional notetakers than for those instructed to use the Matrix strategy, and 38% worse for students instructed to use the Example strategy as opposed to the Example-Matrix strategy. Moreover, Matrix notetakers show a 25% gain in ideas recalled over students using the Example-Matrix strategy.

The relative benefits of instructional aids used in the present study lead to three implications for instructional practice. First, the Matrix strategy is clearly the best technique to teach students if teaching-learning objectives include expecting students to: (a) record many ideas from the lecture and (b) recall the to-be-remembered material. Insofar as the Matrix strategy is consistent with these objectives, retrieval conditions must be established. The presence of cues at retrieval, for example, must be present during encoding to maximize the benefits of the strategy such as Matrix notetaking. Furthermore, test instructions must facilitate the transfer of the material encoded during notetaking to optimize students' test performance. Students' attitude toward Matrix notetaking is expected to
be favorable insofar as the lecture segment lends itself to the Matrix format.

The second implication of the findings is that it is less worthwhile to instruct students how to use the Example-Matrix, Example, and Conventional strategies. If instructors plan to teach students to use the Example strategy to facilitate cued-recall performance, they are better off to combine this technique with a provided Matrix. Otherwise, the Example strategy is no better than Conventional notetaking (at least under conditions like those of the current study). Alternatively, if a provided Matrix is used for instructional practice, it is more effective on its own than in conjunction with the Example strategy.

The third implication emphasizes the instructional importance of informing students about the relationship between the completeness of notes and later performance on relevant tests (Kiewra, 1987; Kiewra, et al., 1987; Kiewra & Fletcher, 1984). The percentage of ideas noted by students is related to the percentage recalled whether they are instructed to write Example-Matrix, Matrix, Example, or Conventional notes. In agreement with prior research (Kiewra, DuBois et al., 1991), present findings confirmed that instructing students to use the Matrix strategy is likely to result in a greater number of ideas recorded as opposed to the Conventional notetaking technique. The
benefits of teaching students to write Matrix notes is apparent by the higher recall scores relative to Conventional notetakers both immediately following the lecture and one week later.

In summary, utilization of the Matrix strategy is optimal to the extent that conditions at retrieval match those at encoding, thereby enhancing good test performance. Instructional practice should be partially aimed at motivating students to master the strategy being taught. Next, implications of the findings for further research are discussed.

Limitations and Implications for Further Research

Upon following the suggestions for future research outlined by Kiewra (1991) and Kiewra (1989), four contributions of the present study add to the existing literature on notetaking to provide a basis for further research. First, the current study examined the benefits of strategies aimed at encoding during notetaking and review concomitantly. Second, the review segments were embedded into the lecture as opposed to occurring after the lecture. Third, students were instructed to utilize the notetaking strategies, and they also demonstrated mastery of strategy utilization. Fourth, a new instructional aid, the Example strategy, was developed with the aim of building external connections in conjunction with the Matrix strategy aimed at building internal connections (Kiewra, 1991; Kiewra, DuBois
The first two of four suggestions for future research stem from theoretical limitations of the present study along with those existing in the notetaking literature. First, investigations have yet to uncover how underlying processes for measures of retention can best be orchestrated with strategies aimed at enhancing encoding and review, facilitating the transfer of the encoded material. In this light, a replication of the present study is warranted with cued-recall replaced by an implicit measure of retention to assess the benefits of the Example strategy.

The Category Accessibility Test described by Roediger et al. (1989) is an example of a measure employing implicit memory instructions. Students are provided with descriptions of various behaviours and are then asked to provide a one-word adjective to describe the behavior that is presented. A similar measure could be used requiring students to provide the relevant category of creativity (e.g., Innovative, Emergentative, School) in response to pertinent behaviors presented for each type. An alternative measure utilizing implicit instructions would be a test requiring students to generate examples of the various types of creativity by utilizing the provided cues. Such implicit measures would perhaps foster the transfer of information encoded during the utilization of the Example strategy.

The second implication is that instructions for the
Example strategy (see Appendix M) could be modified to more closely match the explicit memory instructions for cued-recall, thereby enhancing access to the information available in memory (Roediger et al., 1989). The first and last items for the Example strategy could remain the same (see Appendix M) and the second, third, and fourth items could read as follows: (a) "What cues help to describe the new idea?", (b) "What 'is' the new idea linked to the cues?", and (c) "What is an example of the new idea using the cues?" The revised Example strategy would be categorically-driven to enhance the transfer of encoded information to the cued-recall test.

Third, it would be useful to examine the benefits of pause-time review as opposed to providing a study session following the lecture. Pause-time review has the advantage of enhancing the encoding of ideas presented during the lecture. Lecture variables such as dense material and rapid delivery rates contribute to difficulty in learning from a lecture. Pause-time review strengthens the effectiveness of the lecture by allowing time for students to embellish their notes, adding points that may have been missed.

Finally, it should be noted that the generalizability of the findings may be limited in the present study. First, the findings are generalizable to a sample of high ability students. It is recommended that the findings be replicated with a sample of low functioning students or with students
who have learning disabilities. Second, it should be noted that the present study contained a preponderance of females (62%). Research using equal gender groups is recommended.

In summary, the present research was designed to examine the benefits of Matrix notetaking and Example review, in concert. Further studies are needed to re-examine the benefits of these strategies or to investigate other combinations such as Matrix notetaking (Kiewra, DuBois et al., 1991) and Self-Questioning during review (King, 1992a). It would also be worthwhile to examine the optimal placement of review, embedded into the lecture or following the notetaking session, to benefit the recall of to-be-remembered points presented during a lecture.

Further research efforts should be driven by the encoding specificity principle overlapping with the theory of transfer-appropriate processing. Underlying processes for strategies aimed at enhancing encoding and review, concomitantly, should match processes that underlie the measure of retention. The match between conditions of retrieval and encoding during strategy utilization is expected to foster the transfer of information encoded during the lecture.
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Appendix A

Instructor-Provided Matrix for Notetaking at Posttest:

Types and Dimensions of Creativity

Fill in each cell of the matrix below with the appropriate information given in the lecture.

<table>
<thead>
<tr>
<th>Type of Behaviour</th>
<th>Innovative</th>
<th>Emergentative</th>
<th>School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Display Creativity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Develop Creativity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinguishing Characteristic(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myths Expelled</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix B

Instructor-Provided Matrix for Notetaking Training:

**Types and Dimensions of Assertion**

Fill in each cell of the matrix below with the appropriate information given in the lecture.

<table>
<thead>
<tr>
<th>Type of Behaviour</th>
<th>Nonassertive</th>
<th>Assertive</th>
<th>Aggressive</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Display Behaviour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Develop Behaviour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinguishing Characteristic(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related Characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myths Expelled</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix C

Instructor-Provided Matrix for Notetaking Training:

Types and Dimensions of Irrational Beliefs

Fill in each cell of the matrix below with the appropriate information given in the lecture.

<table>
<thead>
<tr>
<th>Type of Behaviour</th>
<th>Perfection</th>
<th>Approval</th>
<th>Overgeneralization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Display Behaviour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Develop Behaviour</td>
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<tr>
<td>Motivation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Distinguishing Characteristic(s)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Related Characteristics</td>
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<td>Examples</td>
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<tr>
<td>Myths</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Myths Expelled</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

KAK/C-6
Appendix D

Instructor-Provided Matrix for Notetaking Training:

**Types and Dimensions of Irrational Beliefs**

Fill in each cell of the matrix below with the appropriate information given in the lecture.

<table>
<thead>
<tr>
<th>Type of Behaviour</th>
<th>Causation</th>
<th>Helplessness</th>
<th>Catastrophic Expectations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Display Behaviour</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Demand to Develop Behaviour</td>
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<tr>
<td>Motivation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distinguishing Characteristic(s)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Related Characteristics</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Examples</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myths</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Myths Expelled</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Appendix E

Cued-Recall Test on Creativity:

Administered at Pretest

Write down everything that you can remember from the videotaped lecture on Creativity. The types of Creativity were Expressive and Adaptive. The ideas that described Creativity were:
-definition;
-time demand to display and develop creativity;
-motivation;
-distinguishing characteristics;
-related characteristics or dimensions;
-examples;
-myths; and myths expelled.

Include as much information as you can, and be specific about what you say. Use the front and back of this page and please write legibly. You have 10 minutes to complete this task.
Appendix F

Cued-Recall Test on Creativity:

Administered at Posttest and Retention

Write down everything that you can remember from the videotaped lecture on Creativity. The types of Creativity were Innovative, Emergentative, and School. The ideas that described Creativity were:
- definition;
- time demand to display and develop creativity;
- motivation;
- distinguishing characteristics;
- related characteristics or dimensions;
- examples;
- myths; and myths expelled.

Include as much information as you can, and be specific about what you say. Use the front and back of this page and please write legibly. You have 10 minutes to complete this task.
Appendix G

Cued-Recall Test on Assertion:

Administered at Training

Write down everything that you can remember from the videotaped lecture on Assertion. The types of behavior were Nonassertion, Assertion, and Aggression. The ideas that described Assertion were:
- definition;
- time demand to display and develop assertion;
- motivation;
- distinguishing characteristics;
- related characteristics or dimensions;
- examples;
- myths; and myths expelled.

Include as much information as you can, and be specific about what you say. Use the front and back of this page and please write legibly. You have 10 minutes to complete this task.
Appendix H

Cued-Recall Test on Irrational Thinking:

Administered at Training

Write down everything that you can remember from the videotaped lecture on Irrational Thinking. The types of Irrational Thinking were the fallacy of Perfection, Approval, and Overgeneralization. The ideas that described Irrational Thinking were:

- definition;
- time demand to display and develop irrational thinking;
- motivation;
- distinguishing characteristics;
- related characteristics or dimensions;
- examples;
- myths; and myths expelled.

Include as much information as you can, and be specific about what you say. Use the front and back of this page and please write legibly. You have 10 minutes to complete this task.
Appendix I

Cued-Recall Test on Irrational Thinking:
Administered at Training

Write down everything that you can remember from the videotaped lecture on Irrational Thinking. The types of Irrational Thinking were the fallacy of Causation, Helplessness, and Catastrophic Expectations. The ideas that described Irrational Thinking were:
- definition;
- time demand to display and develop irrational thinking;
- motivation;
- distinguishing characteristics;
- related characteristics or dimensions;
- examples;
- myths; and myths expelled.

Include as much information as you can, and be specific about what you say. Use the front and back of this page and please write legibly. You have 10 minutes to complete this task.
Appendix J

Notetaking Inventory:

A Preassessment of Prior Notetaking Skills

I. How often do you usually take notes? (CHECK ONLY ONE THING.)

_____(1) hardly ever
_____(2) sometimes
_____(3) often
_____(4) other (explain)

II. When you wrote notes for the videotaped lecture, how did you do it? (ONE CHECK MARK ONLY)

_____(1) I wrote notes while listening to the lecture.

_____(2) I listened to a part of the lecture and then wrote notes.

_____(3) Other (explain).

III. When you wrote notes for the videotaped lecture, what did you write down? (CHECK ONLY ONE THING.)

_____(1) almost everything, exactly the way the teacher said it

_____(2) mostly main ideas

_____(3) main ideas on one side of the page and facts, definitions or examples on the other side

_____(4) facts below each main idea

_____(5) facts in spaces that matched main ideas
across and down the page

______(6) other (explain)

IV. How do you usually review your notes? (CHECK ONLY ONE.)

______(1) I read my notes over again.

______(2) I write my notes over again.

______(3) I summarize the facts that I wrote down.

______(4) I write questions about the facts in my notes and then answer them.

______(5) I write examples about facts that are recorded in my notes.

______(6) I write the facts in spaces that match main ideas across and down the page.

______(7) I write the facts below each main idea.

______(8) Other (explain).
Appendix K

Postassessment Evaluation Form:

Self-Reports of Strategy Use

1. Did you use the notetaking strategy that was taught?
   Yes_________  No_________

2. Would you have used the notetaking strategy if it had not been taught?
   Yes_________  No_________

3. Do you plan to use this notetaking strategy ever again?
   Yes_________  No_________
Appendix L

Letter of Information

Dear Parents or Guardians,

As part of the school curriculum, your son or daughter will be participating in a research project in education. The project will be conducted by Christine Berndt, who is a teacher and doctoral candidate, and supervised by Dr. John Walsh of the University of Victoria.

Briefly, we are interested in teaching students how to learn to write effective notes to prepare them with skills that will benefit them now and in their future at university. All students will participate in 4 1/2 hours of classroom learning. The project will involve teaching students various notetaking skills, applying the notetaking behaviors to classroom instruction, and assessing the methods of notetaking to find out which skills are the most effective.

Your son or daughter will not be identified, and the information gained will have no effect upon student grades or class standing. We will not be making judgements about the students and are solely interested in finding out the best way to write notes. The findings will be used to help us to better understand how to teach people to be better notetakers. It is anticipated that participants in the project will benefit by learning how to write better notes in the future.
Please feel free to contact Christine Berndt (727-6930), Dr. Walsh (721-7791), or the school for further information. Thank you for your support.
Appendix M

Instructional Guidelines

for Example Strategy Training

1. What is the new idea called?

2. What "is" the new idea?

3. What is an example of the new idea?

4. How do I know the example is right?
Appendix N

Discussion Questions About Writing and Reviewing Notes

For the Conventional Group During Training

Write answers to the following questions about the way that you wrote notes.

1. What did you write down in your notes?

2. How did you know what to write down in your notes?

3. What did you not bother to write down?

4. How did you know what to not write down?

5. What were you thinking while writing notes?

6. How aware of your notetaking behavior were you?

7. What do your notes look like?

8. How well do you understand your notes?

9. How do you make sense of what is written in your notes?

10. What did you do when you reviewed your notes?
VITA

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M.Ed.  University of Alberta  1988

Honours and Awards:

Certificate of Merit  1984
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Title of Dissertation:
Notetaking Strategies for University Bound Learners

Author ________________________________
Christine Anne Berndt
September 29, 1995