

Legal Crib Sheets: Promoting Deep Levels of Processing and Learning

MaryJo O. Smith, Ph.D., Embry-Riddle Aeronautical University

S. Jay Samuels, Ph.D., University of Minnesota

Abstract

The article demonstrates that legal crib sheets encourage deep levels of information processing, an activity that should enhance students' learning and long-term memory. Levels of processing theory states that memory processes exist on a depth continuum; comprehension and synthesis are examples of deep cognitive processes that enhance memory, whereas simple repetition or examining surface characteristics of words are examples of shallow cognitive processes (Craik & Lockhart, 1972). The use of legal crib sheets allowed students to attain significantly higher overall mean test scores while not affecting their long-term retention of the material. Deeper levels of processing occurred because the students manipulated course information in preparing legal crib sheets.

Introduction

The purpose of this article is to demonstrate that students' use of legal crib sheets encourages deep levels of processing, an activity that should enhance learning and long-term memory. The levels of processing theory is a perspective that states that memory processes exist on a depth continuum. For the last quarter of a century, the Craik and Lockhart (1972) levels of processing hypothesis has had a major impact on memory theory. One of the principles underlying the theory is that the strength and durability of the memory trace can be explained as a by-product of the type of cognitive processing used to input information into long-term memory. Comprehension, categorization, and synthesis were thought to be deep cognitive processes that enhance memory. Simple repetition or examining a surface characteristic of a word, such as, does "snails" have one or two syllables, were thought to be shallow cognitive processes that did not enhance memory. From their research, Craik and Lockhart concluded that memory performance is strongly linked to the type of processing used to store information.

The 1969 Hyde and Jenkins memory study was the precursor to Craik and Lockhart's (1972) groundbreaking work on memory theory and memory enhancement. In the Hyde and Jenkins

study, four groups of students were given the task of remembering 12 word-pairs (24 words) that were presented in random order. Group 1 was given an intentional learning task; they were told to memorize the word-pairs because they would have to recall them at a later point in the procedure. Groups 2, 3, and 4 were incidental learning groups. These groups were not told beforehand that they would be required to recall the word pairs; each group was asked to make a different kind of judgmental decision about the words. The different kinds of judgmental decisions were designed to produce different levels of processing. In the experiment, Group 2 was asked to look at each word and decide if the word had letter "e" in it. Group 3 was asked to count how many letters were in each word as it was presented. Group 4 was asked to look at each word and decide if it was pleasant or unpleasant. The processing levels for the incidental learning groups ranged from shallow (Groups 2 and 3) to deep processing (Group 4). Shallow processing directed attention away from the meaning of the word to a surface characteristic such as its spelling or length. Deep processing, on the other hand, directed attention to a semantic characteristic of the word such as its affective dimension, i.e., pleasant-unpleasant. The most striking finding in this study was that Group 4, which used deep

processing to evaluate words on their pleasant-unpleasant dimension, recalled as many words (16.1) as the students in the intentional-learning group (16.3) who were told to memorize the words. Those students who were in the other two incidental conditions (Groups 2 and 3), where processing was based on surface characteristics of the words such as the presence of letter "e" or word length, recalled only 9.4 and 9.9 words respectively.

Craik and Lockhart (1972), working from Hyde and Jenkins' (1969) findings, developed the levels of processing theory as an alternative to a simple information processing model of memory that contained components such as sensory information store, short-term memory, and long-term memory. Each memory component has different characteristics for the variables: memory capacity, rates of decay, speed of input, and speed of output. Craik and Lockhart suggested that the determinant of how much information was to be stored and how long it was to be remembered was not where the information was stored in memory, e.g., short-term or long-term. Instead, they argued that memory storage was determined by the type of encoding process used to input the information. If shallow information procedures were used, the ability to remember the information was not as good as the recall produced by deep processing. Lockhart and Craik's more recent work in 1979 and 1990 has sought a

rapprochement between the levels of processing and information processing models of memory and has attempted to operationalize the encoding strategies that facilitate deep levels of processing.

Memory trace is now generally accepted to be a by-product of cognitive processes such as comprehending, categorizing, conceptualizing, synthesizing, and elaborating (Craik & Lockhart, 1972). Kiewra (1983) reviewed the research on note-taking. He concluded that the act of note-taking by itself is beneficial, independent of the reviewing process that could be done on the notes. What made the process of note-taking beneficial was the extent to which the student was able to make the new information meaningful. In summary, the levels of processing theory stated that more learning and retention will occur when: 1) people work harder at encoding, 2) the information that is to be learned is related to and compared with information that is already in memory, and 3) the approach to learning new information emphasizes constructing meaning (Craik & Lockhart).

Hypothesis

In this experiment, we were testing the hypothesis that when students compress and synthesize a large body of information from their text and lectures in order to construct a legal crib sheet, that deep processing of information is unavoidable. Therefore, when students construct legal

crib sheets, the process should enhance their learning and retention of the course material. Before each exam, the students were given an oral review of the lectures and a written list of the important concepts from the book. The students did not know exactly which concepts would be tested; therefore, what was written on their crib sheets resulted from their thinking about what information was important and likely to be tested. These activities can foster deep levels of processing.

Method

Subjects

The subjects were students in the Learning, Cognition, and Assessment in Schools course, an introductory Educational Psychology course in the Master's of Education program. The course was required for their teacher certification. For these students, the ratio of females to males was 2 to 1; their ethnicity was primarily white; the average age was 31; and on average, they maintained a 3.13 GPA.

The Educational Psychology course in which the research was done was taught during each of the fall and winter quarters of the 1997-98 academic year at the University of Minnesota. The fall enrollment was 108 students and the winter enrollment was 76 students; a few students took the exams in accordance with the University disability policy and their scores could not be used in this analysis. Before this study, statistical comparisons of test grades for the fall and

winter classes indicated that there were no differences between previous classes. The students attended class for four hours per week: three hours of lecture with the professor and one hour of lab in classes of approximately 30 with a graduate student lab instructor. The students in the fall 1997 class served as the experimental group; the students in the winter 1998 class served as the control group. Because random assignment of students to the treatment groups was not possible, this convenience sample was used.

Two exams were given in the course. Students in the fall course were permitted to bring one piece of 8½" x 11" paper to use as a crib sheet during the exams; students in the winter course were not permitted to use a legal crib sheet.

Procedures

Identical instruction, including lectures, reading assignments, and small group activities, were given to both classes. The students were given two multiple-choice exams, each containing 45-questions; identical exams were used during the fall and winter quarter. Exam 1 was given after the sixth class in the quarter; Exam 2 was given after the thirteenth class in the quarter. Each exam covered the content area from the lectures, lab, and book; neither exam was cumulative. The students were given 50 minutes to complete the exams.

At the conclusion of Exam 1 for the fall 1997 quarter, the students were asked to

reflect on their use of their crib sheet.

Eighty-seven students responded to these four open-ended questions:

1. What strategies did you use when formulating your crib sheet?
2. What portion of your crib sheet was from the lectures? From the text?
3. How much did you use the crib sheet during the exam?
4. Did you find the crib sheet to be helpful? How? Why?

Results and Discussion

The descriptive statistics, Table 1, describe the scores on Exam 1 and Exam 2 for both classes. The students taking the class in fall 1997, who had made legal crib sheets, had a higher mean for Exam 1 than the students taking the class during winter 1998, who did not have crib sheets. The descriptive statistics for Exam 2 again showed that the students taking the class in fall 1997, who had made legal crib sheets, had a higher mean than the students taking the class in winter 1998.

Table 1

Descriptive Statistics

	Used Legal Crib Sheets		Did Not Use Legal Crib Sheet	
	Fall Exam 1	Fall Exam 2	Winter Exam 1	Winter Exam 2
N	104	102	74	76
Mean	37.61	37.23	36.39	34.92
Std. Deviation	3.42	4.08	4.21	3.81
Range	24.00	30.00	23.00	20.00
Minimum	19.00	13.00	19.00	22.00
Maximum	43.00	43.00	42.00	42.00

Figure 1. Summary of the Comparisons Tested.

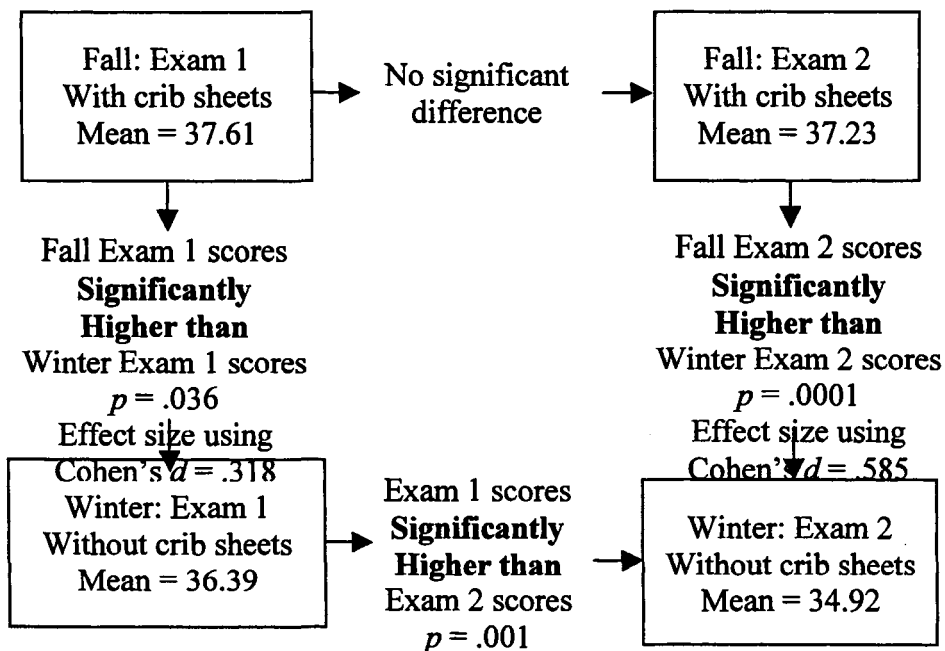


Figure 1 summarizes the experimental combinations that were used in the study. Paired-sampled t-tests were run for each individual class: fall 1997 and winter 1998. There was no statistical difference ($t=.809$, $df=101$, $p=.42$) between the students' overall paired Exam 1 and Exam 2 scores taken during the fall 1997. Therefore, the students' scores were similar for both exams and the students were able to maintain a high score for both exams because crib sheets were allowed on both exams. For the winter 1998 students, who did not use crib sheets, their overall Exam 1 scores were significantly higher ($t=3.335$, $df=71$, $p=.001$) than their Exam 2 scores. Therefore, it appears that a crib sheet might have been helpful in allowing these students to maintain their same grade level.

The results of the independent samples t-test for the Exam 1 showed that the fall 1997 students, who were permitted to use crib sheets, scored significantly higher than the winter 1998 students who did not use crib sheets ($t=2.118$, $df=176$,

$p=.036$), as shown in Figure 1. The treatment effect, as measured by the Cohen's d , was .318, which indicated a small to medium effect size. An effect size of .3 indicates that the mean score of the students using legal crib sheets is at the 62nd percentile of the students who were not permitted to use crib sheets (Becker, 1998). Therefore, this analysis supports the hypothesis that crib sheets promote deep levels of processing resulting in higher levels of learning as expressed in test scores.

The results of the independent samples t-test for Exam 2 showed that there was a significant difference between the scores for students who used legal crib sheets and those who did not ($t=3.666$, $df=172$, $p=.0001$). The treatment effect, as measured by the Cohen's d , was .585, which indicated a medium effect size. An effect size of .6 indicates that the mean score of the students using legal crib sheets is at the 73rd percentile of the students who were not permitted to use crib sheets (Becker, 1998). The students who were

permitted to use the crib sheets scored significantly higher than the students who were not permitted to use a crib sheet.

Qualitative Results

Eighty-seven students responded to the qualitative questions asked after Exam 1 in the fall of 1997. The students' listed the following strategies for how they formulated their crib sheets: using the information from the review session, defining key words and concepts, writing dates for events mentioned in class and in the text, writing notes on important people or articles specifically mentioned during lectures, and including information that they were still learning and had yet to master.

Thirty-two out of 87 students (37%) responded that half of their crib sheet was from lecture notes and half was from the text. Twenty-one students (24%) responded that approximately $\frac{1}{2}$ of their crib sheet was from the lecture and that $\frac{1}{2}$ was from the text. Seventeen students (20%) responded that approximately $\frac{1}{4}$ or less of their crib sheet was from the lecture and $\frac{3}{4}$ was from the text. Eleven students (13%) responded that $\frac{1}{2}$ or more of their crib sheet had more

information from the lecture and $\frac{1}{2}$ or less contained information from the text. Six students (6%) did not respond to the question.

Twenty-nine out of 87 students (33%) said that they used the crib sheet very little. Many students were surprised at how little they used the crib sheet. One wrote, "Less than what I thought I would have to – I guess I learned a lot just doing the crib sheet!" Another wrote, "Not as much as I thought I would. Writing the crib sheet was a good way to study." Finally, "I hardly used it at all during the exam. When I did, it was just to check an answer I had already given." Thirty-four of the 87 (39%) students used the crib sheet for five questions or less. Twenty-three (26%) students stated that the crib sheet was truly helpful when they took the exam; they used their crib sheets for 25% - 50% of the questions. One student did not respond.

Sixty-eight out of 87 students (78%) responded that they felt that the crib sheet was helpful. Only six students (7%) responded that they felt the crib sheet was

not helpful. Thirteen students (15%) did not respond to the questions.

Fifty-one of 87 students (59%) explained how or why the crib sheet was helpful. Forty-one students responded that the process of creating the crib sheet was most helpful. "While it was helpful to have the crib sheet on hand (for the 20% of the questions I used it for), I really learned the most simply by making this crib sheet. It's a great idea." Another student wrote, "I found the crib sheet helpful because it provided me with a great study opportunity. I feel that is why I didn't need to use it very much because I really got to learn the material." Lastly, a student wrote, "I thought this was a good learning tool because I learned a lot while I wrote out my crib sheet. I probably learned more making my crib sheet than I would have learned just studying." Five students reported that the crib sheet helped minimize or eliminate their test anxiety. Five students also reported that the crib sheet was a confidence booster or security blanket.

Conclusion

Legal crib sheets allowed the students to obtain significantly higher overall mean test scores while not affecting their long-term retention of the material. Therefore, deeper levels of processing occurred because the students were manipulating the information as they decided how to represent the course information on their crib sheets. The majority of the students did not extensively use the crib sheet during the exam because they had cognitively learned the material. Depth of processing suggests that the students were able to synthesize the text and lecture materials more deeply while creating the crib sheet. Additionally, they were engaging in good study habits. The qualitative information provided by the students indicated that they appreciated having the crib sheets.

A construct that was not asked qualitatively, but that some student addressed in their qualitative responses was test anxiety. For those five students who

normally have test anxiety, the ability to use a legal crib sheet greatly reduced their anxiety level and allowed them to represent their knowledge more accurately.

Our Educational Psychology course will continue to use legal crib sheets for several reasons: the higher test scores, the reduction in their test anxiety, and the help in organizing their learning. The professors appreciated the deeper processing of the course materials that the legalized crib sheet provided. The creation of the legalized crib sheet is another tool to help our students learn the course material.

References

- Becker, L. A. (1998). Effect size (ES). Available: <http://www.uccs.edu/~lbecker/psy590/es.htm> [2001, November 23].
- Craik, F. I. M. & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11(6), 671-684.
- Hyde, T. S. & Jenkins, J. J. (1969). The differential effects of incidental tasks on the organization of recall of a list of highly associated words. Journal of Experimental Psychology, 82, 472-481.
- Kiewra, K. A. (1983). The process of review: A levels of processing approach. Contemporary Educational Psychology, 8(4), 366-374.
- Lockhart, R. S. & Craik, F. I. M. (1979). Levels of processing: A reply to Eysenck. British Journal of Psychology, 69(2), 171-175.
- Lockhart, R. S. & Craik, F. I. M. (1990). Levels of processing: A retrospective commentary in a framework for memory research. Canadian Journal of Psychology, 44(1), 87-112.