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ABSTRACT

Data from three general psychology classes were used in a study of the chunking method of teaching and studying. Two classes participated in a study on chunking study outline (CSO) length, and one in a study on retention rates. Results of students with high and low cognitive processing capacities (CPC) were also compared. It was found that a CSO should be short, that retention following learning with the chunking method may be near perfect, that test performance was affected by the type of knowledge tested, and that CPC may have some effect on long-term retention. The relation between CPC and test performance, however, appears to be insignificant when using the chunking method. (Samples of short and long chunking study outlines are appended.) (TJ)

Chunking Method of Teaching and Studying: II

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Statement of the Problem

An earlier study (Reference Note 1) found that the success rate (letter grade of C or higher) of provisionally accepted students with low Scholastic Aptitude Test, Verbal scores (350 or less) was increased from 38% to an average of 90% for two classes. Pretest-posttest comparisons (cross-sectional and longitudinal) for these classes were significant. The conclusion was that the chunking method of teaching and studying merited further evaluation for adoption.

The chunking method, in essence, requires students to use their cognitive processing capacity (CPC)(Furukawa, 1977) to determine the quantity of information to be processed at one time and to progressively chunk these discrete units into a meaningful whole. To facilitate the processing of information, a chunking study outline (CSO) was provided by the teacher along with a programmed unit on, among other things, the use of the CSO in studying (Furukawa, in press). The CSO was said to be a "critical element" of the teaching/studying method, as has been substantiated in a separate study (Furukawa, 1977). The CSO consisted of chapter, section, and subsection headings and their key words--normally nouns or adjective-noun pairs that were subjects of paragraphs and sentences. Each line of the CSO was considered to be a discrete unit of information during the

beginning stages of learning, with students studying these in quantities that approximated their CPC. In reviewing, however, students shifted the focus of learning from the parts to the whole by first learning the chapter, section, and subsection headings and then the parts (paragraph and sentence subjects), with the higher-order words serving as nexuses to tie together the lower-order words.

The original study asked and answered a broad question: Will the chunking method of teaching and studying result in an improvement of student success rate? Once a positive answer was obtained, more refined or precise questions needed to be asked and answered. The purpose of this paper is to present the answers to the following questions:

1. Will differences in the length of the CSO affect test performance?

2. Will retention rates differ significantly from the immediate to delayed posttest?

3. Will retention rates differ according to the type of knowledge measured (i.e., discrimination learning, concepts, rules, or problem solving)?

4. Will there be a difference in test performances between high and low CPC students?

The first question on the length of the CSO was based on the dictum given in the earlier study that the CSO was a "critical element" of the method. Since the CSO is of value in the unitizing process and in the reduction of time requirements (Furukawa, 1977), the CSO should be limited to the essential information discussed earlier. Nevertheless, many students were observed to be disregarding this caveat and were adding, for example, complete

definitions and descriptions to the key words given. The value of such additions needed to be determined. Parenthetically, it should be noted that the question of outline versus no outline has already been answered by another study (Furukawa, 1977). In that study, a chunking programmed instruction with the CSO was found to be superior to an identical unit of programmed instruction without the CSO.

The second question on the retention rate differences was raised in earlier studies by other investigators. Sterrett and Davis (1954) surveyed retention rates of information learned at the elementary, secondary, and college levels and concluded that "factual material is readily forgotten whereas concepts and principles are retained with little loss over long periods." (p.457) Especially relevant to the present study are two investigations dealing specifically with general psychology, one by Jones (1923) and one by McKeachie and Solomon (1957). Jones found that most of the facts learned in a college psychology course was forgotten quickly, with only 35% being retained after 8 weeks. After deducting pretest knowledge (54%) from a test given at the end of the course (73.5%) and one given about 8 months later (70.7%), McKeachie and Solomon reported that there was an 85.6% retention rate over the time span.

Based on the retention rate studies, the third and corollary question on retention rate differences based on the type of knowledge measured was raised. According to Gagné's classes of behavior (1965), there is a hierarchy of behaviors, with problem solving at the apex and signal learning (classical conditioning) at the base. Judging from the studies cited earlier, problem

solving, rules (principles) and concepts should be remembered most and discrimination learning remembered least. Nevertheless, the objective of general psychology courses is to teach concepts and principles and not problem solving, which is usually reserved for advanced courses in psychology. The answer to the question on retention differences based on type of knowledge measured was expected to shed some light on achievement of the course objectives.

The fourth question on differences in performances between high and low CPC students was based on earlier findings of a consistent disparity between the performances of high and low CPC students. Examples of this disparity have been found with different learning modes (Furukawa, 1977) and with different information loads (Furukawa, 1970). The viability of the chunking method can be further established if it were instrumental in eliminating or reducing performance differences between high and low CPC students.

Subjects

The data presented here were gathered in three separate general psychology classes: Two were used in the study on CSO length and one in the study on retention rates. In comparison to the retention rate study class, the CSO length study classes had a somewhat restricted range of CPC scores.

Procedure

In the CSO study, one class of students was given a short CSO for three chapters and a long CSO for the next three chapters (see Table 1 for abbreviated versions of both types), with a counterbalanced order of CSO length for the second class. A 40-item multiple-choice immediate posttest was administered

after every three chapters.

In the retention study, students were given a delayed posttest on materials covered in the first chapter, a chapter for which an immediate posttest consisting of 10 multiple-choice questions had been administered about 3 months earlier. The delayed posttest consisted of 12 questions, 3 on discrimination learning, 3 on concepts, 3 on rules or principles, and 3 on problem solving. Students were given a short CSO for the chapter.

For both studies, tests of CPC and a pretest on general psychology were administered to all students.

Results

The results are presented in the order in which the questions were asked on CSO length, retention rates, and CPC.

Differences in the length of the CSO appeared to affect test performances. The result showed a statistically significant difference favoring the short CSO, t (51) = 2.73, $p < .01$. The mean scores were separated by 1.50 points. Translated into letter grades, as many as 38% of the students who used the longer outlines for a particular test could have received a higher letter grade by using the shorter outlines.

Retention rates differed slightly from immediate to delayed posttests. On the immediate posttest, which was given after the completion of the study of three chapters, the students remembered 72% of the materials on the chapter tested. On the delayed posttest, covering the same chapter after a time lapse of approximately 3 months, 66% of the materials were recalled. Adjusted for prior knowledge (pretest scores) of 32%, these percentages become 40% and 34%, respectively, for an overall retention rate of 85% over the 3

months. When the delayed posttest is adjusted to omit problem solving questions (the justification for this was presented earlier and is substantiated in a paragraph to follow), the delayed retention percentage becomes 70% or 38% with adjustment for prior knowledge. With the adjustment, the retention rate becomes an impressive 95% over the 3-month period.

An analysis of the delayed posttest in terms of types of knowledge tested, namely, discrimination learning, concept learning, rule learning, and problem solving, revealed mean scores of 1.92, 2.19, 2.17, and 1.65, respectively. An analysis of variance for repeated measures was significant, $F(3, 369) = 13.36$, $p < .001$. A further analysis showed that rule learning was significantly superior to discrimination learning, $F(1, 123) = 8.06$, $p < .01$. Therefore, differences between concept versus discrimination learning and rule and concept versus problem solving were also significantly different, at least at the .01 level.

The performances of the high CPC students were found to be superior to those of the low CPC students on the delayed posttest only, $t(85) = 1.73$, $p < .05$, with mean scores of 8.38 and 7.76, respectively.

The correlation between CPC and immediate test scores was .13 and for the delayed the correlation was .10. Neither of these correlations was significant.

Conclusions

The findings appear to support these conclusions:

1. Chunking study outlines used in the chunking method of teaching and studying should be short. The CSO should be limited to headings of chapters, sections and subsections and usually

nouns or adjective-noun pairs that are subjects of paragraphs and sentences.

2. Retention following learning with the chunking method may be near-perfect at 95% or at least at the 85% level, with over a 100% gain over pretest scores.

3. Test performance was affected by the type of knowledge tested, with students doing best on concepts and rules.

4. Cognitive processing capacity differences may continue to have some effect on long-term retention, but the relationship between CPC and test performances appears to be insignificant when using the chunking method.

The effect of CSO length differences probably can be attributed to two related factors: One, the more information given, the greater the information load to overtax the CPC of the learner. Two, the more information available, the greater becomes the difficulty of chunking the information, to include selection of nexus words. One other factor may have operated to wrought a dilatory effect on learning. When all of the information was available for reading (e.g., a word and its definition), less effort may be expended in learning. The learner read everything and understood the information. Unfortunately, understanding and remembering are two different processes.

The retention rates may be considered to be superior because of the percent retained, of the gain over pretest scores, and of the ability of the students involved. This third point can be illustrated by the low Scholastic Aptitude scores of many of the students and by the percentage of the information originally known on the pretest. In the McKeachie and Solomon study,

54% of the information was already known compared to 32% in the present study. In short, the students in the present study may have gained nearly twice as much as those in the McKeachie and Solomon study and yet managed to retain the same percentage or more.

The testing for knowledge in the four categories of discrimination learning, concept learning, rule learning, and problem solving provided us with new insights on the attainment of course objectives. In introductory courses, the main objective is mastery of concepts and principles. These are then to be used in future learning of more complex principles and in the correct applications of these principles in appropriate situations. Consequently, little or no problem solving was taught. The results point to the efficacy of the chunking method of teaching and studying in the learning of concepts and principles.

A substantial relationship between CPC and posttest performances has been found in earlier studies of Furukawa (e.g., 1970; 1977). In the earlier studies, this relationship appeared to increase from immediate to delayed posttest unless chunking had taken place. In the present study, chunking probably occurred as the relationship between CPC and test performance decreased slightly from immediate to delayed posttest and both coefficients of correlation were not significant. Nevertheless, the effect of CPC differences seems to have had some influence on the delayed posttest performance, with the high CPC students being superior to the low CPC students. This seemingly contradictory effect may be partially explained by the fact that the latter test was an extreme groups analysis which omitted the medium CPC subjects. The medium group

may represent a good deal of variability, with performances being affected more by other factors than CPC. In the final analysis, the possibility exists that low CPC students may need to carry a reduced credit hour load to give them more time to increase original learning and to overlearn the information for long-term retention.

In summary, the data presented here provided further evidence of the viability of the chunking method of teaching and studying.

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Table 1. Sample of Short and Long Chunking Study Outlines

Short Outline

I. Three levels of memory (p. 178)

A. Levels

1. sensory store

2. short-term memory

3. long-term memory

B. Sensory store

C. Short-term memory

1. seven items

2. chunking

3. rehearsal

4. retrograde amnesia

5. coding

D. Long-term memory

1. highly organized

2. retrieval

a. accessible

b. available

3. cueing

a. mnemonic device

b. categories

Long Outline

I. The three levels of memory (p. 178)

A. Sensory store

1. First receives information coming in from our sense

receptors

B. Short-term memory

1. attention span
2. limited capacity for storage
   a. can only hold 7 items of information at any given time
3. chunking
   a. grouping information together so more can be retained
4. rehearsal
   a. repetition necessary for material to be transferred into long-term memory
5. retrograde amnesia
   a. inability to recall events that took place immediately before a critical event
6. coding
   a. compressing information into abbreviated form.

C. Long-term memory

1. highly organized and relatively permanent
2. the retrieval process
   a. means by which one draws upon information in long-term memory
   b. available memory
      (1) information stored in long-term memory but not necessarily retrievable.
   c. accessible memory
      (1) information that can be tapped
3. cueing
   a. checking each of a number of categories in turn

until one finds the desired information

c. categories

(1) grouping based on similarities among items

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ABSTRACT

Further evaluations of the chunking method provided these four findings: One, "short," as opposed to long, chunking study outlines led to higher test performances. Two, a small difference was found between immediate and delayed posttest retention rates, with 85% to 95% of original learning being retained after a 3-month interval. Three, retention rates were highest for concepts and rules and lowest for discriminations and problem solving. Four, high cognitive processing capacity students were significantly better than the low students on only the delayed posttest, but the correlation was not significant. The findings appeared to add further evidence in support of the chunking method of teaching and studying.

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