Edited by the ASCD Research Council
Frederick A. Rodgers, Chairman

Influence of Time Variations on Learning and Achievement

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INCREASINGLY, professional educators are recognizing that time is a crucial variable in determining learning and achievement outcomes resulting from instruction. The importance of time is evidenced by the fact that time is always a significant variable in a school learning task (Carroll, 1963). All learning tasks in a school setting have either explicit or implicit time parameters that determine both the quality and the nature of performance individual learners exhibit. As greater demands for acquiring new patterns for processing larger volumes of knowledge are made on youthful learners, the management of the time allotted for teaching becomes a critical variable in determining the success of our efforts.

Research regarding the influence of time variations upon effective learning of school-related tasks has taken a variety of forms. Much of the present research in this area is patterned after or is congruent with the model proposed by John B. Carroll (1963). Due to space limitations, only a brief explanation of Carroll's model will be discussed here. According to Carroll's model (1963), the degree of learning is considered to be a function of the ratio of time actually spent *in* learning to the time needed *to* learn.

Time spent in learning is defined by a combination of the smallest value of the following: (a) the time allowed for learning; (b) the length of time the learner is willing to persevere; (c) the amount of time needed to learn. The values representing the time spent and the time needed are the numerator and the denominator, respectively, in the ratio mentioned earlier. It should be noted that the time needed to learn may be extended by poor quality of instruction and by the inability of the learner to understand instructions. One of the assumptions of Carroll's model is that if a learner were allowed sufficient time for learning and were willing to persevere as long as necessary, he would achieve perfect learning. In its most succinct form, the formal explication of Carroll's model is:

$$\text{Degree of Learning} = f\left(\frac{\text{time actually spent}}{\text{time needed}}\right)$$

The research findings on time and its relationship to learning and achievement will be discussed using Carroll's model as a frame of reference.

Shores (1961) attempted to establish whether fast readers were the best readers (higher comprehension scores) when the measurement of rate provides appropriate

scores (an original reading rate; a time for reading the questions, rereading the materials, and answering the questions; and a total time which is the sum of the previous two) for making clear and meaningful comparisons.

The sample for this study consisted of sixth-grade students and a group of able advanced undergraduate and graduate adult readers. Ten rate scores and eleven comprehension scores were obtained from sixth graders reading for two different purposes—for main ideas and for keeping ideas in mind in sequence. Similar scores were obtained from advanced undergraduate and graduate students in the same manner as from the sixth graders. The following is a summary of conclusions drawn by Shores:

1. Fast readers are the good readers when reading some kinds of materials for some purposes. When reading other kinds of materials for other purposes, there is no relationship between speed of reading and ability to comprehend. In general, the fast readers are the good readers on the reading tasks presented in the standardized tests of general reading ability.

2. When either adults or sixth-grade children read the same materials for two different purposes and when the purpose for reading is set for the reader in advance of the reading, the purpose for reading influences the speed with which the reading is done.

3. There is no relationship for either adults or sixth-grade students between comprehension and rate of work-study reading involved in responding to the comprehension questions.

4. Efficient adult readers are much more flexible in adjusting reading rate to the demands of the task than are sixth-grade students. In comparison to the adults, the children read relatively more rapidly as the task becomes more demanding, with a consequent loss in relative comprehension.

The conclusions drawn by Shores (1961) appear to substantiate Carroll's (1963) notion that there is a definite and predictable relationship between what is learned and the time involved in processing information. However, Shores' study gives additional information concerning how the injection of different purposes for completing tasks acts to affect the relationship between time and learning.

In a study of item presentation time per trial in relation to total learning time, Bugelski (1962) focuses attention on the various temporal factors in learning such as exposure time per item, interitem interval, intertrial interval, and total learning time. As part of his task, Bugelski wanted to define a learning trial empirically. Findings from this study suggest that the total learning time is a significant variable to consider in at least some kinds of learning. Bugelski further suggests that while it may be convenient to break up a learning session into blocks of time and to label these blocks "trials," this practice may be questionable in trying to ascertain what the subject is actually learning or doing. It appears that this study supports the notion that a more parsimonious description of learning might be forthcoming if time, rather than the number of trials involved, is used as a variable, thus giving more support to Carroll's view of the problem.

In a study constructed to test the Carroll model, Sjogren (1967) concludes that the results supported the model, in that a measure of the degree of learning from the study of a program one time was significantly related to the ratio of time taken to time needed for the study of the program. The data provide evidence that time ratios have a significant linear relationship with measures of learning, with two achievement tests, and with an aptitude measure, thus providing additional evidence to support the credibility of the Carroll model.

Jester and Travers (1967) studied the effects of various presentation patterns on the comprehension of speeded speech by tracing the two conditions of increasing and decreasing speed. These researchers conclude that when the rate at which material is presented is increased, there is no gain in comprehension after the second display of the material. It was apparent that a fast presentation after a slow presentation did not add to the material retained. Conversely, by decreasing the rate of presentation on successive trials, the learning curve continued to

rise throughout the different rates of presentation and reached a higher level of learning than either of the other rate-of-presentation conditions. When a constant rate-of-presentation condition is used, the level of learning achieved lies roughly between increasing and decreasing modes of presentation. According to these results, it could be concluded that maximum learning occurs when the rate-of-presentation nears the optimum level required by the learner for mastery. This conclusion is weighted in the direction of the argument underlying the Carroll model.

In a study which assesses two possible strategies for accommodating individual differences in pacing requirements when the pace must be controlled externally, Kress and Gropper (1966) conclude that achievement scores tend to decline as the tempo increases (a finding similar to that reported by Jester and Travers, 1967). Kress and Gropper also observed a general pattern which revealed that the mean performance was highest when characteristically fast students worked under a fast fixed tempo, and when characteristically slow students worked under a slow fixed tempo.

They concluded that the lowest mean achievement scores resulted when there was a failure to match characteristic work rates and externally controlled tempos. Their notion seems to parallel the ideas generated by Carroll's model.

Research conducted by Rodgers (1968), concerned with programmed and flexible modes of presentation, revealed the following:

1. The method of presentation affects the rate variation of pupils when they are asked to perform related tasks.

2. Pupils with different operative rate patterns will show different achievement outcomes when exposed to different modes of presentation.

3. The rate of work is the best predictor of gain in achievement if the method of presentation is flexible (fast workers will be superior achievers).

4. The rate with which learners complete the criterion test can be predictive of performance when the mode of presentation becomes a variable.

In general, Rodgers' (1968) findings support Carroll's notion that the degree of learning is a function of the ratio of time spent to time needed.

From the evidence presented by findings from studies dealing with diverse learning problems, it is apparent that Carroll's model offers a meaningful framework for explaining learning in terms of temporal components. If this model continues to reveal its strengths for predicting learning outcomes based on an analysis of the ratio of time spent to time needed, it will serve as a needed pattern for furthering professional educators' knowledge of the effects of instruction on learning and achievement while providing information about the way the learner approaches the material to be mastered.

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