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THE PROGRAMMED TEXT AS AN AID TO TEACHING
SPELLING IN JUNIOR HIGH SCHOOL

by

Gordon Howard Nicholls

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Psychology

Approved

UTAH STATE UNIVERSITY
Logan, Utah

1965

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Gordon Nicholls

TABLE OF CONTENTS

INTRODUCTION 1

 Objectives 2

REVIEW OF LITERATURE 3

 Learning Theory 3

 Programmed Learning 20

 Spelling 33

 Summary of Major Trends 47

HYPOTHESES 48

PROCEDURE 49

 The Programmed Text 49

 Pre-Testing 51

 Experimental Program 52

 Post- and Transfer Testing 52

RESULTS 55

CONCLUSIONS 60

LITERATURE CITED 61

APPENDIX 67

LIST OF TABLES

Table	Page
1. Pre- and Post-spelling test and language aptitude	56
2. Transfer spelling test and language aptitude	58

LIST OF FIGURES

Figure	Page
1. Cache-Logan programmed text testing design	53
2. Samples from "Blue" and "Yellow" forms	54

INTRODUCTION

Organized education, historically, has been slow to commit itself to any sort of intensive examination of how learning can be both analyzed and substantially improved. But today Komoski (1960) tells us that we are looking beyond the traditional approaches to teaching. If a newly developed method is shown to be more effective than the techniques which have traditionally been employed, it is carefully considered for incorporation into the current education program.

Programmed instruction is just such an example of a recently developed teaching method which claims it will contribute much to education. It dates back to Pressey's report (1926) of a simple teaching device which also gave tests and scores. Extensive research into this method, however, has occurred only during the past ten or twelve years.

The intense interest in programmed instruction is understandable when we consider the goals of education in this country. The chief aim of education is to help each student achieve his fullest potential. The schools can best accomplish this by helping each student to recognize his own capacities, and by using methods which will contribute to an individual's developing intrinsically within himself the motivation for learning.

However, there are present-day pressures which hamper the realization of these goals. Today the world is confronted with a population rise unprecedented in history. This "population explosion" is clearly reflected in the burgeoning school enrollments and the accompanying problems of inadequate classroom space and limited facilities. Unfortunately, the

consequences of these pressures prove consistently detrimental to the establishment of an ideal educational system. For example, the increased teacher load has resulted in the practice of double sessions which has tended to reduce the amount of individual attention many teachers were previously able to devote to each student. And more extensive demands upon school budgets have led to minimal teacher salary raises, contributing further to the shortage of qualified teachers.

This reveals the importance of development of new educational media in order to alleviate some of the stress on the teacher and to keep pace with currently expanding fields of knowledge.

Objectives

The main objective of this study is to determine whether principles taught for one group of words will carry on to another group of words.

The second objective is to observe the instructional effects of using a programmed text in spelling as compared with several other methods of teaching spelling, such as: rote drill, by teacher context and word study, use of standard spelling workbooks, and combinations of these methods.

REVIEW OF LITERATURE

The purpose of this review will be to investigate learning theory as a background for educational research, the general area of programmed instruction, and teaching methods in spelling. The intent is to cite representative studies in the literature in these three areas, particularly as related to this project. The review of learning theory will be primarily historical.

Learning Theory

The reason, according to Skinner (1958) that Pressey's experimentation with teaching machines in the 1920s did not arouse much enthusiasm was because of the inadequacy of appreciation of the prevailing principles of learning. The conditions under which learning occurs are better understood today, and the place of learning as a basic reference point in psychology has resulted from extensive experimentation on the part of many people.

The perennial problem of educators has been to find solutions to the practical learning problems with which they have had to cope. Theories of learning have, over the years, proven beneficial to the refinement of educational methods. They have served as guides and sources of stimulation for research and for scientific thought. They have at least attempted to summarize a large amount of knowledge about the laws of learning, thus representing a gain in breadth, in organization and in simplicity. And theories of learning have attempted to explain what learning is and

why it works as it does.

After centuries of thought and millions of words, men are still trying to understand the nature of the learning process. As Kramer says, "Theories follow theories; contradicting, replacing, modifying, ignoring, supplementing or re-verbalizing their predecessors." (Kramer, 1955, p. 227)

Hilgard, in his "Theories of Learning" (1948, p. 359) acknowledges the fact that much is known about learning and that as a matter of fact the amount of knowledge about learning is enormous. However, the fact still remains that it is the consistent ordering of this voluminous material into a compact and agreed-upon systematic structure which is lacking.

One useful system from which to view learning theories is seen in the associationist-cognitive dichotomy. This approach divides learning into, generally, the school of conditioning, wherein learning is a matter of connections between stimuli and responses, and into the cognitive group which treats learning as a concomitant of such activities as perception, attitudes or beliefs. A major difference between the two is that in the latter, cognitive concern with behavior allows for the power and flexibility of man's intellectual processes.

Because of the range of activities of interest to the psychologist, some psychologists prefer to place emphasis on the organism's interactions with its environment such as the sensory discriminations, manipulatory, locomotor and other energy interchanges with it. Other psychologists choose to emphasize more covert aspects of the organism's activity, such as the cognitive, perception-like and idea-like processes.

This has resulted in the already mentioned more or less dichotomization of interests among psychologists in their formulizations and applications of learning theory. Hilgard (1948) mentions that the preferences of the theorist often leads him to concentrate upon one kind of learning situation, to the neglect of the others. This difference in preference comes as a result of searching for causes of and ways of predicting behavior. The major source of disagreement it appears is not, as some might superficially think, between ways of defining behavior. As Hilgard tells us, the disagreement is largely due merely to interpretation:

While it is extremely difficult to formulate a satisfactory definition of learning so as to include all the activities and processes which we wish to include and eliminate all those which we wish to exclude, the difficulty does not prove to be embarrassing because it is not a source of controversy as between theories. The controversy is over fact and interpretation, not over definition. (Hilgard, 1948, p. 7)

Association theory

The associationist trend in studying learning has provided the deepest inroads to the psychological understanding of what constitutes learning. Associationism has its beginnings in Aristotle and, as Deese (1958) tells us, runs strongly throughout British philosophy from the seventeenth to the nineteenth century.

Associationism refers to the similarity or the contiguity between different elements of behavior. It tends to attribute as much of its explanation of behavior to learning rather than to the organism which is interacting within its environment. Complex habits are viewed in terms of the simpler habits comprising the whole or entire pattern of behavior. It will be seen later that the cognitive theorists, on the other hand, prefer, rather than breaking behavior down into its essential parts, to

consider individual elements in respect to their interaction within the pattern of which they are only a part.

Watson (1930) was an early connectionist theorist whose objective and relatively simple attempts at exploring behavior did not allow for the effects of conscious experience. For him behavior was nothing more than movement of muscles resulting in sequences of conditioned reflexes. The flaw in his theory of behaviorism, though, was that he could not give the unconditioned stimulus which caused the conditioned stimulus to result in a response. Watson's contributions to theoretical thinking, however, do include the famous principles of frequency (the more frequently we have made a given response to a given stimulus, the more likely we are to make that response to that stimulus again) and recency (the more recently we have made a given response to a given stimulus, the more likely we are to make it again).

Guthrie was another informal connectionist who made contributions to learning theory. He is perhaps the best known advocate of the stimulus-response contiguity theory.

This association theory is closely related to Watson's principle of recency. Watson believes that the strength of a stimulus-response connection is something that varies in strength and grows with practice. Guthrie on the other hand, says conditioning takes place completely in one experience and further practice adds nothing to the strength of the connection. He makes no use of reinforcement, but says the successful act is the last one that occurs in the problem situation and that it will tend to occur if the problem is presented again. He says that we learn not by success or by reinforcement, but by doing. Guthrie's contention

that we learn by doing will be recognized as one of the fundamental principles of programmed instruction.

Deese (1958, p. 39) tells us that in this kind of association theory, the function of reinforcement is simply the mechanical one of providing an end to the stimulus-response sequence. Guthrie's conception of reward is that it serves to prevent a person from unlearning what he has already learned, by keeping him from reacting in other ways to the stimuli that lead to the response.

E. L. Thorndike would also be considered a connectionist reinforcement theorist. He was one of the first experimental psychologists to explore the adaptive characteristics of reinforced behavior. He differed from Guthrie in that Thorndike said animals learn the correct response gradually instead of in a single stimulus-response pairing.

The law of effect was Thorndike's primary law of learning. This law, which led to our current operational notions of reinforcement, said that rewards tend to "stamp in" behavior. He stated (1932) that stamping in of stimulus-response connections depended not simply on the fact that the stimulus and response occurred together, but on the effects that followed the response. Hill (1963) explains this law by saying that if the stimulus was followed by a response and then by a satisfier the connection was strengthened. If the stimulus was followed by an annoyer, the connection was weakened. Later Thorndike modified the law and made satisfiers more permanent than annoyers. Reward strengthened connections but punishment did not directly weaken them. If punishment was effective at all in weakening the tendency to do something, it was because it produced variable behavior and thus gave some new response a chance to

be rewarded. Thorndike implied in his writing that reinforcement acts upon both what the subject learns and what it does; that reinforcement is necessary for learning.

Thorndike's contributions to the field of education are evident when we study methods of programming school material. A particular factor of considerable significance to programming is that of delay of information and learning. A delay in reinforcement may disrupt behavior and slow down the rate of learning. Lorge and Thorndike (1935) proved this and suggested that it is more than simply the passage of time that is important in the effects of delay upon information and reward. This hypothesis was also verified by Saltzman (1951) who demonstrated a brief delay in reward and information in rote verbal learning can have considerable effects upon the number of errors made by subjects during learning.

Another member of the connectionist-reinforcement camp is B. F. Skinner. He was similar to Thorndike, in that he also had a keen interest in education and preferred to de-emphasize theory. Skinner is unique, though, with his recognition of two kinds of learning, each different because they involve a different kind of behavior: respondent behavior and operant behavior.

Respondent behavior is that behavior which is elicited by specific stimuli. We are born with some, such as reflexes. Others are acquired through conditioning and follow the same pattern as classical conditioning. However, Skinner does not use that term. In respondent learning acquired through conditioning, a new stimulus is paired with the old (unconditioned) stimulus. The unconditioned stimulus serves as a reinforcer, since without it learning couldn't take place. Respondent learning is the same that Watson (1930) assumed made up all kind of learning.

Here though Skinner emphasizes the role of the unconditioned stimulus.

Most behavior, for instance walking or talking, could be classified, according to Skinner, as operant behavior. An operant response depends upon a variety of stimulus conditions and is not made up of specific stimulus-response connections. Guthrie (1952) analyzes every bit of behavior as emitted by the organism, without considering the multitude of stimuli that have something to do with its occurrence. Skinner's operant differs from Thorndike's reflex in that the reinforcer for the reflex is an unconditioned stimulus, while the reinforcer of an operant is a reward.

Skinner also studies the effects of whatever variable he manipulates, concentrating largely on the one variable: schedule of reinforcement. His extensive work with reinforcement is one of the reasons for his being a leading, if not controversial, figure in the programmed materials movement. Skinner's schedules of reinforcement refer to the patterns according to which reinforcers follow responses, i.e., ratio schedule: frequency of reinforcement depends on the rate at which responses are emitted. Interval schedule: depends simply on the passage of time. Fixed ratio schedule: reinforcer is presented consistently after every so many responses. Variable ratio: the reinforcer is presented after a different number of responses on different occasions. Fixed interval: a fixed interval of time has to elapse after one reinforcer is delivered before another can be obtained. The first response following this period of time is reinforced. Variable interval: The reinforcer is obtained sometimes sooner and sometimes longer after the previous one.

Two of Skinner's contributions to the psychology of learning include free operant behavior and schedules of reinforcement. These two results

of his experimenting are of particular significance in the area of programming as will be pointed out later.

Neal Miller, a professor of psychology at Yale, has formulated a system not very different from Skinner's. However, it is more theoretical and borrows heavily from the theory of Clark Hull. Miller, an experimental psychologist, is closely associated with Dollard, a clinical psychologist. Together, they have adopted learning principles to the understanding of fear and neurosis. They have applied this knowledge in explaining and developing methods of psychotherapy. Nevertheless, some of Miller's experimental findings have contributed to learning theory. In their first book (1941) they explain the psychology of imitation and say that many people solve problems not by trying various responses until one is rewarded but merely by imitating the actions of others. This work supports the principle of developing unique problem-solving abilities in students. This principle is of importance to the field of programmed instruction. Developers of programmed materials devote much of their time to making programs wherein students are required to formulate their own concepts and construct their own responses to questions with which they are faced.

Clark Hull has probably contributed more terms, ideas and techniques for formulating psychological questions than any other theorist. Hull's (1943) method was to form postulates which would serve as beginning points for logically derived statements called theorems. These theorems formed laws of behavior. Hull was a behaviorist but differed from Watson and, indeed, from all the informal theorists by his more formal, sophisticated theory.

Hull, who had previously been an engineer, utilized the mathematical approach in constructing a neatly organized, all-encompassing yet complex attempt at predicting behavior. His "master theory" started with an accounting of a seemingly indefinite number of independent variables, proceeding through two stages or organization into intervening variables which in turn influence the dependent variables.

Some areas of his theory were rarely alluded to in his subsequent work. Other postulates and corollaries received heavy emphasis. His broad coverage of the entire range of behavioral phenomena was certain to emphasize some aspect of learning theory which would prove of some importance to programming. One such example was his examination of the weakening effect on response tendency of a delay between the response and the reinforcement.

The preceding discussion of association or S-R theories was intended to present some of the implications that those theories have for the understanding of learning theory with respect to its effect on programmed instruction. Following is a selection of theories based on a completely different frame of reference, yet which contribute, also, to our understanding of learning theory and its place in programming.

Cognitive theory

The second main group of theories is known as the cognitive or field theories. Classified herein are varieties of gestalt, neo-gestalt, organismic and sign-significant theories. Though there is not complete agreement among the various cognitive theories on all issues, they still can be assembled together under one heading because of the common underlying logic which they do share. Aside from being commonly opposed to associa-

tionist conceptions, the cognitive theorists have among their theories, according to Hilgard (1948), five basic points of agreement.

First, they have a preference for nativism. That is, they account for behavior according to the way the organism is made. They consider behavior to be a function of contemporary arrangements, independent of prior experience.

Secondly, cognitivists prefer to observe behavior, and thus explain learning, from the interaction of all the factors together, or from what they term the "natural" viewpoint. This is the concept of the whole being greater than the sum of its parts, and is the main tenet of the Gestalt school of psychology. Deese (1948) refers to this school as one of the classical grand systems in psychology. Gestalt psychology, which can be taken as fairly representative of field psychology, holds that:

The whole is composed of all its parts so conceived--no more, no less. Alternatively, a whole may be thought of as a unique pattern of organization of the parts, in which case the whole has properties beyond those of its parts, or is "more than its parts." Thus a house has an architectural unity which is "more" than the materials of which it is composed. These alternatives--considering wholes according to their composition or according to their organization--represent a second difference in preference between association and field theories. (Hilgard, 1948, p. 11)

Hill (1963) tells us that with all the emphasis on unified wholes, this does not mean that cognitive psychologists never recognize separateness. Instead, however, the way in which distinct entities are separate or stand out from the background against which they appear is of importance in understanding the part they play within the total pattern.

The third major distinguishing characteristic of the field psychologist is his acceptance of a form of introspection which is called phenomenological. This is a form of subjectivity which allows for personal interpretation of such things as shadows and contours. Because of the field

psychologist's interpretations of experiments and his insightful learning, he disagrees with the associationists.

A fourth distinction is the point along a range of choice, in the selection of the physical model, at which the field psychologist's view diverges from that of the associationist. Where the associationist's laws are rigid the cognitivists have a dynamic, more fluid model. Hilgard very neatly describes the cognitive model when he says:

A different model is provided by whirlpools, candle flames, and soap bubbles, in which the parts are related to the whole in a less rigid manner. You can scoop a bucketful of water out of a whirlpool without changing it. The whirlpool, candle flame, and soap bubble are illustrations of dynamic equilibria... (Hilgard, 1948, p. 14)

The fifth line along which the two schools of thought differ is that of the historical importance of behavior. Cognitive theory says it is the concern with the present that is important. No matter how important past experience is, it is the contemporary structuring of the field in which the problem occurs that counts.

In this introduction to the cognitive theorists, some room has been left for comparison between the two opposing types of learning theory. Rather than have limited this specifically to field theory, it was thought that the approach utilized would still be an acceptable preface to inspection of the individual field theories which are to follow.

Max Wertheimer might be considered the Father of cognitive thought since it was his Gestalt theory which launched this philosophy. Cognitive theory is of utmost significance to programmed learning since it plays a major part in a conflict occurring today within the field.

The Gestalt movement was originally started because of Wertheimer's objection to psychology's traditional means of scientific investigation

in which they broke something down into segments and then examined individual portions separately from the original, entire phenomenon. It is this entirety of form or pattern that is referred to by the German word, Gestalt. The central theme of Gestalt psychology has been mentioned previously. Nevertheless, the most outstanding help of Gestalt to the understanding of learning theory has been through the concept of insight.

Kohler (1925) is well-known for investigations into insightful learning in animals. His experiments have revealed the intelligent, cognitive thought processes possible in apes. He and Koffka both used their evidence to back up attacks against the then popular trial and error learning theory of Thorndike. American psychology at the time was pretty firmly ensconced in the quagmire of Watsonian behaviorism. This new return of thinking and understanding to respectability was provided not by an altogether forgotten or abandoned doctrine. Insight was never derived as an actuality. Its restoration, however, did serve as a revolutionizing influence in the thinking of American psychology.

Trial and error learning had been determined by experiments which exhibited much fumbling, with only gradual improvements and little understanding of how improvement took place. Insight, though, has been described by Hilgard (1948) as that experience in which the learner obviously perceives a relationship which leads to problem-solving. He has adapted Yerke's (1927) eight criteria of insight into six characteristics of insightful learning which summarize the problems insightful learning set for learning theorists. These six characteristics tend to draw from the works of no particular Gestalt writers, but do, however, appear to be factors derived from insight experiments.

Hilgard's six characteristics include:

1. Insight depends upon capacity. Animals higher in the phyletic scale (e.g. apes) achieve insightful solution more readily than those lower in the scale (e.g. guinea pigs).

2. Insight depends upon relevant previous experience. Associationists have inferred that the mere possession of the needed past experience would produce a solution, because the solution includes nothing but familiar operations previously learned. Gestalt psychologists don't deny the influence of previous experiences but do object to the neglect of the associationists of the primary principle of organization. It is the meaningful relationship of previously learned experiences, which makes a problem-solving a unique phenomenon. A school child may perfectly well understand the significance of individual, conventional symbols encountered in his every-day course work. This, however, does not guarantee that the learner will be able to constructively organize the bits of previously learned information into a cognitive or mental relationship. It is this ability to relate meaningfully which has significance for learning theory, and is referred to as insight.

3. Insight depends upon the experimental arrangements. This means that if the significant features of a problem are so arranged in order to avoid much distracting, extraneous material, the learner is then more able to perceive the necessary features in their proper perspective. One example of how to achieve proper arrangement of the meaningful segments of a problem or pattern is to provide, through review, an overview or candid picture of the meaning or uniqueness of the particular learning experience.

4. Insight follows a period of fumbling and search. It is a process of mentally rearranging the materials at hand in order to arrive at a

meaningful relationship. It involves juggling parts around just like a jig-saw puzzle. This may result almost instantaneously in a solution but generally does require some period of thoughtful fumbling and search.

5. Insightful solutions can be readily repeated. Insightful learning is the development of a meaningful pattern of behavior which is not as easily forgotten as some hypothetical, trivial, perhaps even nonsensical stimulus-response bond.

6. Insight, once achieved can be used in new situations. Hilgard mentions that this sixth characteristic refers to one's ability to react to a more abstract learning relationship, undisturbed by slight changes in the situation.

Kurt Lewin was another member of the previously mentioned cliche of men who professionally comprised the Berlin School of Psychology. Lewin was more interested in motivation and social psychology, though, whereas the other men (Wertheimer, Kohler and Koffka) were concerned primarily with perception, learning and thinking. Lewin did not derive a theory for learning. What he was after though was a theoretical system for predicting an individual's motivated behavior. And this he found in his concept of life space, the meaning of which is defined by Hill (1963, p. 105) as the totality of facts which determine the behavior of a given individual at a given time.

Lewin, himself, suggests the characteristics of his field theory to be:

The use of a constructive rather than a classificatory method; an interest in the dynamic aspects of events; a psychological rather than a physical approach; an analysis which starts with the situation as a whole; a distinction between systematic and historical problems; a mathematical representation of the field. (Lewin, 1942, p. 215)

Lewin's life space refers to the entire realm of reality for an individual; that existing within or about him of which he is conscious. This includes the reality of physical objects, interpersonal relations, thoughts and dreams. Lewin explains behavior in terms of the cognitive structure of a given situation; of the life space. This cognitive structure or organization gives behavior a psychological direction; provides a perceptive awareness of how to arrive at the correct solution to some problem. Lewin says:

In an unstructured, or new situation, the person feels insecure because the psychological directions are not defined; in other words, the person does not know what action will lead to what result. (Lewin, 1942, p. 228)

The person's adaption, however, to a situation with which he is unfamiliar and in which he feels insecure may involve a change in any part of his life space. This may include the psychological past. It may occur on the reality level or on the irreality level (wish and fear level) of each of these sections of his life space.

Life space is a construct, like other constructs, to account for a psychological situation at a given moment. Although its primary contributions to learning theory are specifically in the area of motivation, Lewin has helped the cognitive cause by stressing the importance of using a sophisticated cognitive approach for studying individual behavior in preference to the method of generalizing, used by the associationists, in explaining behavior in terms of laws applicable to all people.

The next and last cognitive theorist we shall consider in this review is Edward Tolman. His contribution to learning theory was Purposeful Behavior, a system wherein he attempted to give cognitive theory

as close a connection with external stimuli and with learning as connectionist theory had. Purposive means goal-directed. Tolman's description of behavior is also referred to as one of molar behavior as opposed to molecular behavior. A molar explanation describes only the most general characteristics of behavior, i.e., goal-directed rather than analyzing behavior microscopically, such as in terms of S-R bonds. Molar behavior cognitively makes use of environmental supports in achieving the goals. It seems to take the path of least effort. It is characterized by teachability.

Tolman focused his studies of behavior around purpose or goals, using cognitions as intervening variables. He explained their existence by saying:

The fact of these cognitive aspects is readily illustrated in the case of a rat's behavior in the maze. After a rat has once learned a given maze his behavior is a very specific dashing through it. But the continued release upon successive occasions of this same very specific dashing can easily be shown, experimentally to be so and so. It is contingent upon such and such alleys actually being shaped the way they are. For if any of these environmental facts be unexpectedly changed, i.e., no longer prove to be so and so, this given behavior, this given dashing will break down. It will exhibit disruption. Its continuing to go off as it does, constitutes, then, the objective expression of a set of immediate contingencies... It is such contingencies (assertions) for which the generic name cognitions seems appropriate. (Tolman, 1949, p. 17)

Tolman's Purposive Behavior theory seems to have borrowed from quite a few other theories. There are several points which "pure" Gestaltists would not willingly accept as being truly Gestalt in nature. Tolman still holds, however, that Purposive Behaviorism and all Gestalts are still sign-Gestalts; and all relations in the last analysis, means-end relations. His Gestalt did amount to a serious attempt at exploring the whole activity of theory building and served to pave the way for attempting to combine the best features of cognitive and connectionist theory.

Attempts at describing the learning process have been numerous. The system-building theories reviewed in this report are larger in magnitude and scope and could generally be considered more significant for their particular contributions toward an appreciable understanding of human learning.

Other theorists and researchers, many of whom have concentrated on particular theoretical concepts have combined specific points of several other theorists in arriving at their valuable conclusions. There have been many people who, through their continuous efforts, have discovered many revealing facts concerning learning.

Of primary importance for educators, and of utmost significance to programming has been the development of systematic training procedures and techniques which have been found effective in modifying the behavior of experimental subjects in sharply predictable ways. From these experimental techniques have resulted findings closely paralleling those conclusions obtained from experiments involving animals of other than the human species.

The theoretical basis for programmed instruction revolves primarily around an analogy between animal and human learning, the law of effect, and the principle of reinforcement. Keeves (1962) warns that the relation of the simple characteristics of programming to these principles, however, is still obscure and that there is still no general agreement concerning learning theory.

Deterline (1962) has concluded that there do exist some basic psychological principles of learning which are of particular significance in respect to auto-instructional devices. Some of them will be explained in more detail, as they are encountered in the next section.

Programmed Learning

Programmed learning is a method of learning wherein the student is guided systematically through a lesson by means of material which is arranged (programmed) in a sequence of steps specifically designed to efficiently produce a maximum of learning with a minimum of error. This type of instruction is called programmed instruction. It involves the use of teaching aids which because of the almost automatic way in which a lesson is regulated according to the student's ability, are commonly referred to as auto-instructional devices. These devices vary in their complexity. But they are generally one of two types: the teaching machine, or a book which is appropriately termed the programmed text.

The primary function of programmed instruction is to arrange for learning to take place. This function is achieved through activity resembling that which takes place between a tutor and the student. The principles of learning involved in this activity can best be identified by looking closely at the tutorial process.

The tutor engages a student in constant cognitive activity. This is accomplished by asking questions to which the student responds after having thought, guessed and put different ideas together. The tutor makes sure the student understands the significance of some part of the lesson by rephrasing and approaching the point in question from different aspects. The tutor repeatedly tests his student's understanding. He then adds additional information to the previously acquired knowledge, enabling the student to gradually formulate more complex concepts through the incorporation of new ideas. The tutor in this way can continually check his student's progress. If learning has occurred in one step then learning can proceed in succeeding steps. If learning, however, has not

occurred in some particular step, as evidenced by the subject's inability to respond to his tutor's questioning, then the discourse returns to a step within the instructional sequence to which the students can respond favorably. From this point the student is led according to his own rate of assimilation, step by step, through the lesson. This is the familiar procedure used by Socrates, the master tutor, many hundreds of years ago.

Auto-instructional devices attempt to duplicate this same learning process through the presentation of the carefully arranged and revised instructional material. In addition to giving information and requiring a response, the programming device indicates the correctness or incorrectness of the response, providing the student with the necessary assurance of whether or not he is adequately prepared to proceed in the lesson.

Research has been abundant in this recently reactivated area of instruction. Lumsdain (1959) among others attests to the functions of this automated tutor as being the following:

1. The learner selects or constructs a response to a question with which he has been presented.
2. The learner is presented with the answer with minimal delay (immediate feedback). The thought processes employed in arriving at his answer, if correct, are thus reinforced and he can proceed with confidence to the next learning situation.
3. The learner progresses at his own pace.

One outstanding research study in Manhasset, New York, according to Komoski (1961), employed a pre-test in English grammar, constructed by the local principal. This pre-test is currently being used to eliminate the sections of grammar which may be omitted by students with appropriate mastery. Mr. MacGowan, the principal, lists four advantages of programmed

instruction:

1. Each student can complete his work in grammar at his own pace.
2. There is a great saving of time for the student. The best students in the class are completing a year's work in grammar in 12½ hours.
3. It eliminates the problem of loss of instruction due to illness, trips, etc., as well as the problem of how to work a new student into classwork.
4. It pinpoints student errors thus directing study to the material which needs particular attention.

Beggs and Miller (1961) contend that instead of putting the student in competition with his peers for the attention of his tutor, the auto-instructional device pits the student against his own ability.

Skinner insists that thinking consists of "self-management" or learning to pay attention and that "teaching machines with their control over the consequences of action, can make sure that paying attention will be effectively reinforced." (Skinner, 1961, p. 397)

There are opinions which strongly clash with those of the optimists, however. Rock (1961) recommends that teachers utilize machines for routine tasks, thus allowing more teacher time on planning and working with individual students. He considers such tasks for which the machines could be used to be grading papers, keeping attendance, and drill. Bruce (1961) indicates a lack of flexibility and adaptability on the part of the devices, and suggests need for further improvement.

Nordberg declares that automated teaching devices are an outright threat to education. He says: "Partly because the machine cannot think, cannot program itself, it cannot in the last analysis help us at all in the crucial business of teaching students to organize and express what

they know." (Nordberg, 1961, p. 364)

The reactions have been many and varied. Barr (1961) is more conservative. His attitude is reflected in more of the recent writings. Rather than heaping a great deal of praise or lashing out vehemently at the programmed movement, Barr makes suggestions for improvements, specifically stressing the need for carefully controlled experimental studies of teaching machines. His suggestions include:

1. Exploratory studies to make clear the needs served by each machine, to indicate types of learning with which each is helpful, and to suggest the conditions under which it has produced desirable pupil growth and achievement.

2. Cost studies would consider time, money, energy and values.

3. Comparative studies should follow or become a vital part of cost studies.

Komoski (1960) offers three sound reasons for adopting programmed instruction:

1. It is a practical method of individual instruction wherein the teacher is able to tutor each student in the art of interrelating and of applying what he has learned to new and challenging non-programmable situations.

2. Its effectiveness can be clearly demonstrated in precise, objective terms. In other words, in programmed instruction, education has a method by which different approaches and attitudes toward various subjects can be subjected to detailed scientific scrutiny.

3. The creation of programs is a remarkably effective teacher-training tool. Experience in programming teaches them much more about their own teaching, and instruction in general, than any other teacher-

training they have had.

In the classroom, the emphasis while using programmed materials will be on the behavior of the students and on the various ways in which learning can be produced. Deterline (1962) mentions that Rousseau specified the ideal learning situation as one in which a tutor can devote his full attention, ingenuity, and time to the instruction of one student. The Socratic dialogues offer earlier proof of benefits derived by the student from an active interplay between himself and the teacher.

Historical overview of programming

The teaching machine of S.L. Pressey was the forerunner of our present-day programmed instruction movement. Pressey observed the time consumed by the teachers, of his day, in scoring endless tests and quizzes and argued that if labor-saving devices are possible in the home and in the office, why not also in the classroom?

The machine he devised is about the size of a small typewriter. A multiple-choice question appears in a window in the machine. The student might answer the question on the basis of prior study of his textbook, a lecture or some other source, including what he had already learned from answering preceding questions in the series. The student was either informed of a correct answer by presentation of the next question, or, in the event of an incorrect answer he was faced with the same question while his error was at the same time recorded.

However, the general public, educational administrators and teachers were unable to accept his approach or the need for further investigation; and he said in 1932 that he was turning his interests and attention to other problems (1960).

Following Pressey's earlier work, Skinner ignited the present widespread interest in programmed learning with his article: "The Science of Learning and the Art of Teaching" (1954). He had shown it was possible to train a wide variety of animals to perform quite complex behavior in response to a simple stimulus. His experimental work on an investigation of the effects of reinforcement in learning suggested to him that since the species of organisms appeared to make very little difference, the learning processes of humans were essentially similar to those of animals. He proceeded to apply his learning theory to programming.

A visit to a fifth grade arithmetic class, where his daughter was working, revealed to Skinner (1954) three great weaknesses in classroom instruction. First, learning was dominated by restrictive control; even where avoided, the teachers' displeasure or criticism was essentially punitive in nature. No intrinsic interest and motivation for learning came from the way in which the material was being taught. Second, where reinforcement was provided, it was given long after the task was completed. The teacher marked the work book and returned it to the student the next day. Experimental work with animals had indicated that the reinforcement must be given immediately. Third, there was a noticeable lack of skillful instruction with a course that moved through a carefully designed sequence of steps, from initial simple behavior to its final complex form.

In the years following 1954, several machines were built and tested by Skinner. They were the result of his experimental findings that by arranging appropriate "contingencies of reinforcement," specific forms of behavior could be set up and brought under the control of specific classes of stimuli. All were based on the educational principle of motivation which says that it is not merely a matter of teaching a student

what to do; but being concerned with the probability that appropriate behavior will, indeed, appear at the proper time.

One early machine, developed for elementary arithmetic, had a window through which a problem or question printed on paper was viewed. The child responded by shifting sliders with the numbers 0 to 9 marked on them. Two partially adaptive teaching machines, now obsolete, are the Skinner disc machine and the Rheem Didak version of it. With both, the learner wrote his answer to the question on a separate sheet of paper and moved a lever to cover his response with glass while exposing the correct answer. Thus the learner constructed his response and scored it. Another more recent model by Norman Crowder is the Auto-tutor, one which requires the student to select rather than construct a response. Still more recent are electronic gadgets which tally mistakes, indicate the source of error, and redirect the student to previously covered material in accordance with his particular error. And another recently developed means of implementing learning with printed materials, but without the use of hardware, is through the use of programmed and scrambled text-books, each of which uses a specially designed format to achieve conditions parallel to those called for by machines. A review of some of the principles and styles of programming should make the significance of the programmed text, used in this research project, more understandable.

Prompting vs. confirmation

The basic unit of a program, the frame, introduces material to the student in small amounts at a time. A series of these frames, each adding to the information previously imparted, gradually contributes to the development of a concept. This conceptual development is induced either by prompting or confirming. In the prompting situation, the correct infor-

mation is available to "prompt" the learner with no need for response or confirmation. The programmed material is usually presented in the usual frames of the program with the blanks filled in but the response term underlined. The material is sometimes arranged in paragraphs, dropping the frames with or without underlining. Confirmation means that after the subject responds to the challenge of a blank space in the frame by supplying a missing word he is then provided with the correct answer.

Silberman (1962) in his summary of research on prompting vs. confirmation, has found that the prompting condition was superior in 7 out of 12 studies and that it took less time in 10 of these studies. Better learning was produced by confirmation in only two studies but the confirmation in no cases took less time.

Silberman, Melaragno, and Coulson (1961) studied the effects of a text version in which the fixed sequence items with blanks filled were arranged into paragraph form. This was considered a prompting version because there was no need for response and confirmation, and the answers were all present. They used three conditions: first, prompting without review, or the items put into a statement form and presented in the fixed-sequence order; one statement at a time; second, fixed-sequence, constructed response, confirmation; and third, textbook or prompting with review in which the same material was organized into paragraphs and the students were free to choose material at their own option. No significant differences were found among the three groups on a post-test but both prompting groups took less training time.

A study by Angell and Lumsdaine (1960) has shown that prompting on 3 out of 4 trials is superior to prompting on all trials.

Reinforcement

Reinforcement is quite a controversial concept in psychology. It has been one of the central principles in programmed instruction, and is according to Skinner, one of the most important. In effect, reinforcement means that certain environmental effects strengthen the behavior which has produced these effects. Skinner (1958) believes reinforcement refers only to those operations which strengthen learning, irrespective of confirmational effects.

On this point, however, there is far from unanimous agreement. MacPherson, Dees, and Grindley (1949) support the view that confirmation in the form of knowledge of results is an important factor. But there is far from any unanimous decision over whether or not the confirmation is effective because it simply supplies information as Skinner believes. Tolman (1949) says this strengthening is the result of the feedback of information per se. Hull (1943) would have this strengthening of the response as a result of need reduction. And Guthrie (1935) says reinforcement is the result of protecting the associative connections.

Gagne (1958) in defining confirmation and reinforcement as two different processes, reasons that when motivation depends upon the nature of the task, as when successful completion of the task is a goal, reinforcement is provided in the form of knowledge of results. Carr (1959) also makes a distinction. He takes Gagne's position to mean that confirmation is reinforcing only if the learner's motivation is intrinsic to the task being learned. He thus argues that confirmation and reinforcement are two distinct classes of variables. Porter (1957) considers the possibility that confirmation may lose its reinforcing property over a period of time because of a weakening of the novelty effect.

In Pressey's comments (1960) on auto-instruction and reinforcement he says that when a student is informed about the correctness of his answer to a question and then led to the right answer the experience serves as more than a test. It is also a learning experience from which the student benefits. According to learning theory, answers found wrong, but not corrected, tend to be repeated. Auto-instructional devices, however, provide that the learner always is informed about the correctness of every answer to every question on a test. This information is given immediately. Pressey tells us that in some auto-instructional devices, if a mistake is made, the learner is at once guided to the right answer. The important point to remember is that what was done last is what will be remembered. If the last thing a student did was to correct an answer which was contrary to that exhibited by the machine then this will probably be remembered. If the last response of the student was to correct an answer through following the procedures outlined by the machine, this no doubt could prove to be even more meaningful. Both examples demonstrate Thorndike's primary law of learning, the law of effect, which states that reward strengthens a response. In the two examples cited, seeing the corrected answer verified by the answer given in the machine is a reward. Acknowledgment of the correctness of one's response serves as reward. The probability of this response occurring in a similar situation has thus been reinforced through the reward, pleasure, joy, etc., of observing one's own accomplishment; namely answering the question correctly. This situation serves in addition, as an example for Watson's behaviorist theory of recency; the more recently we make a given response to a given stimulus, the more likely we are to make it again.

The above defense of Pressey's for reinforcement in auto-instruction is supported by some others, (Little, 1960; Peterson, 1960; Pressey, 1960). Each of these studies found that immediate knowledge of results produced more learning. In each case, however, study review tests were used instead of programs. Moore and Smith (1962) in two separate studies, each using linear constructed response programs, found no significant differences in learning between those who learned by means of conventional programs which gave reinforcement and those who learned by means of the same program without knowledge of correctness of their responses. Feldhusen and Birt (1962) studied nine methods of presentation of programmed learning materials, using linear constructed response programs, and also found no significant differences among those programs providing reinforcement and those providing none. These new findings indicate the challenge which programmers must face in their future research endeavors.

Overt vs. covert response modes

According to Skinner (1958), the characteristic of automated techniques that has purportedly accomplished the goal of provoking the student to respond actively to the material to be learned has been the requirement for the student to make some response during learning. It is typically intended to prepare the learning material such that all students will be able to respond correctly nearly all the time.

Many programmers have insisted that to be active the student must construct answers and the constructed answers must be written. This is called an overt response. The covert response does not require a written observable response.

A number of studies have been done in order to investigate whether overt activity is really superior to covert activity. Holland (1960),

and Krumboltz and Weisman (1961) both find that overt responding resulted in fewer errors. Most results in the past three years, however, have tended to find either no significant difference or have favored covert responding.

Sidowski, Kopstein, and Shillestead (1961), and Evans, Glaser and Homme (1960) found covert responding facilitated better learning. Silberman (1962) has summarized fifteen such studies and has seen that whether or not there is an overt response required seems to make no consistent difference except that there was a saving in time by using the covert response.

The Center for Programmed Instruction has reported (Eigen and Komoski, 1962) another typical experiment and found no significant differences between those who read the program (covert response) as compared with those who wrote answers (overt response). This particular experiment supports many others which find that covert is as effective as overt response and that covert response reduces the time necessary for completion of the program.

Transfer

Gagne and Dick (1962) have reconfirmed, in their study, the possibility of defining the performance task as concepts learned which can be transferred to other situations more or less similar to those in which the concepts were learned.

Briggs, et. al. (1962) found an interesting difference in transfer in respect to mode of response. When they used a measure utilizing items highly similar to those practiced in the learning condition, the overt response group was slightly but not significantly superior to their

covert or reading group. When the transfer test consisted of items which varied considerably from the original items the covert response group did better. They suggest that: "The motivation to construct the response during learning interfered with use of all the relevant information presented in the frame." (Briggs et. al. 1962, p. 89).

It is Kendlar's (1959) opinion that it is more important to know what it is that is being transferred from a particular learning experience. He suggests the value of tests of transfer and rejects Skinner's assertion that the only measure needed to assess learning from programs is the number of frames completed. Kendlar says:

Increased knowledge about the psychology of transfer and symbolic processes would enable us to program courses that will generate the kind and amount of transfer we desire...I might also add if we knew a bit more about transfer we could have more confidence that good programming would become a scientific technology instead of remaining an art. (Kendlar, 1959) p. 177-186)

Criticisms and implications for further research

Silberman (1962) mentions a trend toward more diversified research approaches to programmed instruction. There have been, for instance, an increasing number of analytic studies, field tests, case studies, and single-organism exploratory studies. Many of the resulting programs are venturing from the earlier subject matter type and are focusing on creativity, problem solving and inductive reasoning behavior.

He goes on to say:

It is to be expected that the heightened research activity in programmed instruction will lead toward more carefully written, empirically developed textbooks; toward instruction that is more directly contingent on frequent testing; toward a greater relative emphasis on development of instructional materials, in contrast to the presentation of those materials; toward a greater effort devoted to the maintenance or retention of learning, in contrast to

its acquisition; and toward a greater emphasis on specifying the behavioral goals of education. The programming research signals a shift in emphasis toward placing a greater burden of responsibility for learning on the quality of the instructional materials. (Silberman, 1962, p. 17)

Carr has voiced his criticisms against experiments on programmed material versus other methods. He specifically mentions the lack of controls in the experimental and control groups but does not spell out the lack of controls in the stimulus material, programmed or text, which are used.

Experimentation has been carried on at a feverish pace in programming. Much has been discovered and much remains yet to be uncovered. Komoski mentions that much more research activity will be needed if programmed instruction is to grow as effectively as it believed possible. He goes on to say that no matter how theoretical or pragmatic the immediate problem, most of this research will have to be done within the schools.

Spelling

Spelling is a process of translating oral words into graphic symbols by means of visual memory, and phonetic and motor clues. It is the establishment, through correct habits, of a complex sensory motor process in which eye, hand, and articulatory muscles must all be coordinated.

Modern English spelling is characterized by complexity. Its difficulties and inconsistencies can be attributed to many factors such as: persistence of regional speech, the respelling of Anglo-Saxon words after the Norman Conquest, the indifference to consistency in spelling of early writers, the changes in inflections, etc.

In addition to these causes of spelling difficulty there remains the one determinant, the treatment of which consistently baffles spelling

authorities. That is the great variety of distinguishable sounds for which there are no single representative symbols. Phoneticians (1960) recognize this perplexing problem and have revealed numerous vagaries peculiar particularly to English spelling, such as the fact that the long e sound can be spelled fourteen ways in common words, only about 1/5 of the time with e alone, and that the letters c, q, and x are actually superfluous. Hildreth (1955) mentions that more than half of the words in a dictionary contain silent letters. And according to Horn (1957) about a sixth of the words contain double letters, although only one letter may be pronounced. Discoveries such as these have brought about several attempts at extensive reform, however, no immediate prospects of worth are in sight. Schools are left, without any foreseeable solutions, therefore with the task of carefully selecting and arranging the course of study, and discovering and applying efficient methods of teaching.

Besides the character of the language, there are several other factors which contribute considerably to the difficulty of English spelling. Williamson (1933) isolated seven factors important in learning to spell: span of apprehension, knowledge of meaning, verbal intelligence, perception of word form, generalization of phonetic units, rote memorization, desire to spell.

Horn (1950) claims one study indicates that attitudes of students are likely to be influenced by the teacher's own attitude toward spelling. And he has indicated that those who learn best through one form of imagery tend also to learn best through others, except for pupils with highly specialized disabilities.

Knoell and Harris (1952), as a result of their factor analysis of spelling test scores, confirm Horn's report that imagery seems to be a

contributing factor in spelling ability. But they go on to admit that though various perception areas lead to the formation of images, we know little about their influence and precise formation.

Principles of spelling

As a result of the considerable amount of research that has been done with spelling, numerous lists of spelling principles have been arranged. Hildreth gives us a number of basic principles that govern learning to spell, principles which apply equally well to learning of other language-related skills:

1. Learning to spell is dependent upon mental and linguistic growth in the learner.
2. Spelling is best learned in the larger area of language usage of which it is a part.
3. The pupil learns best with understanding of the nature of the skill and the purposes for which he is learning it.
4. The pupil makes the most progress who at all times makes a strong, active response in his efforts to learn and gives sustained attention to the task. The pupil's interest in learning and in improvement play a large role in mastery of spelling and other writing techniques.
5. Learning to spell involves the development of increasing refinement in visual, auditory, and motor perception, and memory of the material perceived.
6. Learning results in part from imitation from observing writing being done.
7. Some trial and error is involved in all learning of spelling and other mechanical details of writing.
8. The development of generalizing abilities so far as these can be applied in English is an important aspect of learning to spell.
9. The pupil's attitudes, his feelings and emotional reactions to words, to school study, even toward the teacher, play a large role in learning spelling as in learning all other skills.
10. Outcomes from the pupil's attempts to spell have an important bearing on interests and attitudes toward further study.

11. The teacher's management of the learning situation will largely determine the pupil's attitudes toward the learning task. (Hildreth, 1955, p. 26)

According to The Encyclopedia of Educational Research (1960):

1. Calling attention to difficult parts of words in presenting the words of a lesson is a doubtful practice.

2. Stressing hard spots by underlining, writing in capitals, or using boldface type was of little or no value.

3. The effectiveness of instructional procedures in spelling is heavily dependent upon the development of desirable attitudes, such as intention to remember, and aggressive attack.

4. Games and special devices may supplement but should not supplant systematic instruction.

5. There should be ample provision for distributed reviews, each guided by a test to show which words need additional study.

6. Perceptual analysis can apparently be improved by training.

According to Hall:

1. Educators should not discourage analogical reasoning ability in the young learner. Spelling "munny," patterned after "funny," is using one's intelligence to extend the patterns of spelling that he has already learned. When the student applies the principles of elementary analogical reasoning in his spelling he should be encouraged to continue but also to adapt or adjust to the many irregularities of the English language.

2. Degree of difficulty in word reading refers to the irregularity of correspondence between grapheme and phoneme.

3. Don't use pictures. They encourage a child to guess.

4. The entire structure of English graphemics can easily be presented in ten elementary readers, which can be covered in not over two

years.

5. Don't stress speed in the beginning. Instead, include the intermediate steps of letter-sound association, development of analogical reasoning ability, development subsequently of self-confidence.

6. Teach for meaning. Introduce him to new concepts and new ideas which he would not meet in his ordinary everyday life. (Hall, 1961, pp. 29-31).

Teaching methods

The question of which teaching methods are best has been asked for a good number of years. Research has consistently concluded that different teaching procedures produce little or no knowledge difference as evidenced by student gains (Birney and McKeachie, 1955; Buxton, 1956; and Kidd, 1952). Nachman and Opinchinsky (1958) on the other hand, have recently found that different teaching methods have, in fact, produced differential amounts of learning but that these effects have been masked in the measurement process.

Drill has been classed along with the prevalent practice in high school of pointing errors out to students but giving little instruction. Both are negative factors. Students who are poor in spelling are likely to have a defeatist attitude when they reach high school. This is often manifested in defiance, evasiveness, or deliberate non-conformity. Hildreth says; "When this is the case, corrective work must start with remaking the student's attitudes rather than with drill in techniques for spelling improvement." (Hildreth, 1955, p. 268)

Gates (1956), in reference to drill, says that in the separate spelling period procedure, when the word is first introduced the tendency is to strive for considerable over-learning and then to follow with heavy

doses of review at intervals in the hope that the spelling of each word is thoroughly over-learned. The end result is that the burden is thrown on the relatively inefficient and poorly motivated formal repetitive drill. The rote learning of particular words is thus emphasized.

"To the neglect of developing increased expertness in the techniques of independent, insightful learning." (Gates, 1956, p. 278)

There are certain words which every child must know since these words will be used in the writing of the majority of students. Therefore, spelling authorities have concerned themselves with which words and with how many they should confront students. This has resulted in several lists. The earlier spelling books contained as many as 12,000 words inclusive of those the child would probably come across in his reading. Present day spelling texts attempt to present only those words which the children will probably write; approximately 4,000 words. Dolch (1960) questions the need for studying twenty words a week for six years in order to learn the 4,000 "commonest" words in written English, however. He says that after 1,000 words, it is only with exceedingly decreasing reliability that most commonly used words can be selected because the identity of frequently used words will vary according to the subject under consideration. He quotes Horn's earlier study of 1924 which examined 1,000,000 running words of adult correspondence and found that only 500 different words comprised 82.05 percent of the most used words, and 1,000 different words comprised 89.61 percent.

Hildreth says that conventional list methods of teaching spelling leave much to be desired and includes among his limitations, the following:

First, the standardized nature of the word lists and the rigid way in which the lists tend to be used; second, the disparity between practicing the spelling of words in isolated lists and the way in which words are used in writing; third, the assumptions that every word to be spelled needs separate memory drill and precisely the same amount of drill or type of practice on identical word lists, and that a week's drill on twenty words will insure permanent learning. (Hildreth, 1955, p. 10)

Syllabic analysis, as a method of teaching spelling is over eighty years old. Syllabication requires students to spell orally by dividing a word into syllables, either by drawing vertical lines between the syllables or by covering parts of the word so as to expose only one syllable at a time. Early research findings indicate a slight advantage in presenting words in syllabicated form. However, with the development of more refined analysis techniques, later studies (Horn, 1947, Humphrey, 1954) showed that, in general, no significant advantage seemed apparent. Horn (1950) mentions that we know from various investigations that adults, mature students and superior spellers do tend to study words by syllables. He also says that syllabic analysis is not appropriate for primary children and should be used sparingly even with pupils in the intermediate grades. Its justification is based primarily on the enrichment effect it has on integration of language activities.

Fitzgerald tells us that the student can benefit much through incidental learning, but the student's proficiency in writing will be improved if he is taught an effective method for the mastery of a properly selected basic core vocabulary:

Provision must be made to guide each individual to achieve the goal of correct spelling in writing, especially because of the fact that a child's difficulties, interests and needs are different from those of every other student in learning to spell. Within any single grade

the knowledge that different children have varies greatly in spelling. Therefore, systematic teaching of spelling should begin where incidental learning leaves off.

Petty says that, "Major emphasis in teaching spelling needs to be given to eye-spelling, which means being able to form a clear, correct visual image of the word." (Petty, 1959, p. 5)

He classifies the complex process of perceiving and recalling into such different ways as: eye-spelling (seeing), ear-spelling (hearing), lip-spelling (saying), hand-spelling (writing) and thought-spelling (thinking). He regards those forms other than eye-spelling to be supplemental kinds of spelling knowledge, for instance, because our spelling is largely nonphonetic and most spelling rules have too many exceptions to be very useful to most children. And hand-spelling is also supplemental because it is a habit of recall which has developed only over a long period of time.

Hall, in regard to "phonetics" recognizes that English spelling is uneconomical in symbolizing the thirty-two or more spoken sounds (phonemes):

Although there are not enough graphemes to "go around" in proportion to all the phonemes needing to be symbolized, there is a marked lack of economy--one might well go so far as to say that there is apparently a tremendous confusion--in the choice of graphemic representation for our English phonemics. (Hall, 1961, p. 23)

But he goes on to say, however, that there is a basic pattern to the way in which the English spelling system symbolizes the language. There are irregularly spelled words but, there are very few words which are wholly capricious in their spelling; and even irregular spellings are not by any means wholly random.

He criticizes the "global recognition" or "see and say" methods which starts the beginning speller off with a large number of irregularly

spelled words. He mentions that instead of the child being taught that every word is a separate item whose spelling he must learn in and for itself, the child should instead get the idea that there is regularity, some fundamental principle in English spelling. The student should be taught that graphemes represent phonemes instead of the notion that written words stand directly for "ideas," for real-life meanings.

He makes the following suggestions:

1. A student should be taught to master the alphabetic principle of being able to pronounce any combination of letters that he sees. A reasonable correlation between sounds and letters renders repetition unnecessary.

2. A student should be taught to read by developing his analogical reasoning ability.

3. A properly planned series of developmental reading texts should be based on the principle of graded selection of words in terms of their difficulty.

4. Spelling is best learned by the fundamental principle of passing from the least difficult to the more difficult. Rapid reading is achieved by first learning to read slowly and then speeding up on the basis of a knowledge of what is to be expected in any given context.

5. Introduce the student to new concepts and new ideas which he would not meet in his ordinary everyday life.

6. Go through the spoken linguistic forms which the written shapes symbolize.

7. Then attempt to correlate written words directly with real-life meanings.

8. Phonemes do not occur in isolation, so do not teach children to associate separate letters with individual sounds.

9. So-called "phonic methods of teaching reading are not much better than other extremes of "see-and-say" or "reading for meaning" methods which neglect the basic alphabetic function of our orthography.

Gates (1956) says that children must learn to become alert to the spelling of words in everyday writing. Although the current research stresses teaching for sound rather than the, up until now, popular system of teaching for meaning, he contends that the student's trouble with spelling might still lie in the infrequency with which the student writes the particular word; and that this can be partially corrected by usage in context instead of mere learning and review. Spelling charts are in practically every classroom in our country. This commonly used method of teaching spelling, according to Blake, typically says:

Hear the word correctly
 Look at the word
 Say it aloud to yourself
 Close your eyes, look away, try to remember
 how it looks
 Look at the word and study it again
 Write the word
 Check the spelling
 Write the word 3 to 5 times. (Blake, 1960, p. 29)

The purpose of spelling charts is to stimulate independent study. But Blake questions whether the chart realistically provides for thorough independent study. He says that because every child is asked to do the same thing, conformity in the concept of word study is encouraged rather than the original, diverse and truly independent thinking about words. Use of charts denies recognition of the fact that there are "private" ways of studying words which might differ completely from those used by any other pupil. The children thus left on their own tend to develop wasteful devices due to the lack of adequate teacher guidance.

The spelling bee has been recognized as definitely a negative approach to the problem of teaching spelling. Barbe (1956) has noted that no speller becomes better because he has to sit down the minute he misspells a word. It provides little motivation for the poor speller for he must sit, bored, while the better spellers show off their skills. Further evidence against a spelling bee is that it emphasizes spelling words incorrectly. Attention is not given to words which are misspelled.

Campanale (1962) says that a spelling bee is still worth having about once a semester in the junior high school, despite its oral character. He says that for educative purposes, motivation for work in mastering a particular set of words comes from requiring everybody on either side to keep on spelling. Instead of a person dropping out, a mark should be tallied against his side for every word he spells wrong.

Calhoun tells of a variation of the spelling bee. As one particular phase of an intensive teaching method, he made use of supplementary word lists. Because of the wide range of achievement, the members of the class were divided by the teacher into two groups. Fifth-, sixth-, and seventh-grade word lists were used for the upper group; and third-, fourth-, and fifth-grade words for the lower group.

As each boy was spelled down, his name was placed on the figure of a ladder in the order in which he went out. The boy who stayed up longest and was rated number one in his group was given the first word the following day and risked being the first to go down. This system afforded each boy an opportunity to compete with pupils of nearly equal ability on words at his own level. It also afforded him an opportunity to watch the changes in his daily standing and tended to foster alertness toward the words spelled by him.
(Calhoun, 1954, p. 156)

Fry (1960) mentions the use of the tachistoscope as a particularly effective method of teaching spelling. This is so because some primary children become discouraged at the sight of a whole page of printing.

Children in remedial reading classes have sometimes especially learned to hate a page of printing. He reports success with reputedly "hopeless cases" by having them read from filmstrips which are projected onto the screen. A game-like atmosphere is induced by flashing the word on the screen as quickly as an eye blink (tachistoscopically). The child is dared to see the word and write it down. This method is probably better than the spelling bee for instance because when a student misses it the teacher or another student reads it aloud, so that it can be heard and associated with the visual-written image which has been shown on the screen again. According to Fry, the tachistoscopic method of teaching spelling is effective because it involves such learning principles as (a) feedback; (b) learning set; (c) multi-sensory approach; (d) use of small units which increase the frequency of the rewarding effect of knowledge of results; and (e) the use of the screen in a sheer novelty-manner which is not like other reading experiences.

The study-test versus the test-study method of teaching spelling has received quite a bit of attention. The study test-method requires that a small group of words be studied carefully for meaning and pronunciation. The student writes the word, attempts to recall it, and is finally tested on it.

The test-study method utilizes a basic list of spelling words from which weekly assignments of words are made. A somewhat standard approach as described by Staiger would be:

On Monday the new words are studied, as well as the review words from previous lessons. They are pronounced, discussed, and every effort is made to insure understanding. Then a pretest is administered, so that the student can concentrate on learning those words he misses. On Tuesday the students study the words misspelled according to the plan suggested by the author. Wednesday is devoted to word study as it is related to the words in the lesson. Phonics,

syllabication, and other pertinent word exercises are used. On Thursday, more word study activities lead to the post-test on Friday. (Staiger, 1956, p. 283)

Schoephoerster (1962) mentions a study by Horn, and three others which collaborate Horn's conclusion that of all the teaching methods, the test-study method, utilizing the corrected test procedure, could be the most efficient single procedure for learning to spell.

Schoephoerster, himself, has completed a study which seems particularly outstanding. He compared the value of three variations of the test-study plan of teaching spelling featuring the corrected spelling test as used by children to learn the correct spelling of the words of the weekly textbook spelling list, and to retrain the knowledge of the spelling of these words. During the first four-week experimental period the group followed a variation consisting of a pronunciation and meaning exercise and initial corrected test on Monday and a mastery test on Friday of each week. During the second four-week experimental period, the pupils engaged in a pronunciation and meaning exercise and initial corrected test on Monday, a midweek corrected test on Wednesday, and a mastery test on Friday.

During the third four-week experimental period, the pupils followed a variation consisting of a pronunciation and meaning exercise and initial corrected test on Monday, a midweek period of word study on Wednesday, and a mastery test on Friday.

His recommendations were:

1. Since children of above average ability had learned almost all of the words in the spelling list, incidentally, they should use a method requiring the least expenditure of class time.

2. Children of average spelling ability should follow a test-study variation which incorporates into it a second corrected test on a midweek

period of word study.

3. Below average students should utilize a fifteen minute midweek period of word study as a part of the test-study variation.

His findings are particularly significant in that they contribute to the general theory that pupils should concentrate on words at their ability level; and that teaching methods should be flexible enough to allow for individual differences in spelling ability.

Barbe and Gannaway (1956) say that with the increased aid being given to those children who have difficulty learning to spell, no method seems best for all children; only variations in particular methods and combinations of methods which are best for individual children should be used. In a study which he conducted in three twelfth grade classes in English using a different technique in each, Burton (1953) drew the following conclusions: (a) There was no conclusive evidence that any of the three methods of teaching spelling was superior to the others. (b) There was some evidence that all three methods brought some improvement in spelling which covered a period of three months.

A study in spelling conducted by Harris (1948) using pupils of the junior and senior high school as his subjects brought out the following implications: (a) There is a need for systematic instruction in spelling in all grades at the junior and senior high school levels. It cannot be assumed, he says that all of the necessary skills and abilities have been learned sufficiently in the elementary school to carry the student through subsequent grades. (b) There is a need for a differentiated program of instruction in the junior and senior high school: (1) The wide range of spelling achievement among junior and senior high school pupils indicates a definite need for differentiated instruction at these

levels. (2) Certain pupils will need special help in learning to spell special words.

Summary of Major Trends

Laboratory results in the past have consistently supported the experimentalists' hypotheses that confirmational feedback and active participation such as writing out the correct answers in a programmed lesson produce better learning. Current studies, however, tend to disprove these principles of learning. It is not necessarily the verbal behavior, or physical activity such as writing out an answer that contributes to the formation of concepts. Current thinking, among researchers is that such factors as motivation, and experimental designs based on human behavior, specifically, are of more significance. Many of the programs are focusing on creativity, problem solving and inductive reasoning behavior. And the emphasis seems to be toward placing a greater burden of responsibility for learning on the quality of the instructional materials.

There is little literature pertaining to programmed spelling instruction. But there does appear to be a significant trend toward rejecting certain time-honored methods of teaching spelling. Rote memorization, list teaching and spelling bees have been dismissed as inefficient. More refined analysis techniques have disproven the validity of syllabication. Phonemics appears to be replacing the traditional "see and say" method. And use of the tachistoscope and the test-study method have both appeared more effective than other means of teaching spelling. Current research does specifically tend to highlight the need for differentiated programs of instruction, over and above any of the varieties of teaching methods.

HYPOTHESES

The following experimental hypotheses were proposed:

1. Transfer from one set of words to another will be limited since each word at this level tends to be a separate problem.

2. A self-guided program will produce results equal to drill, use in context, or teacher-guided programs of instructions covering the same material.

3. A combination approach using the program plus other forms of instruction will be superior to any single method.

The first hypothesis relates to the objective of determining whether a skill taught for one group of words will carry over to another group. The remaining two relate to the objectives of determining whether other approaches achieve superiority in original learning and transfer.

PROCEDURE

The Cache-Logan Spelling project was an experiment in the use of a programmed text in spelling at the secondary level, sponsored by the State of Utah, Department of Public Instruction.

The subjects were students from five junior and senior high schools in Cache County, Utah. Twelve teachers originally began the study, but the final analysis was based on ten. This was because schedule changes resulted in one teacher's two groups being too small for study purposes; and because one teacher had only one group with which to experiment.

The Programmed Text

The Cache-Logan programmed text was prepared in a modified Skinnerian style and covered eight units. Each page contained ten frames which stressed the "Socratic" or question type approach. The answers were given after each four pages.

Instructions at the beginning of the text were as follows:

You will find these lessons are written to help you become a better speller. When you begin the lessons, you will find that there are ten sentences, or paragraphs, (called "frames") on each page. Each is numbered. When you read the frame it will be like talking directly to the instructor. In almost every frame you will be asked to write something. In each case, you should write on the special answer sheet which you will be given. Write only on that sheet. Do not write on these pages, since they will be used again by other students. At the end of every four

pages is a sheet of answers. You are to check your own answers by drawing a line through any you did wrong, and writing the correct answer. It is best to go through all four pages before correcting your work, unless otherwise directed. However, you may check at any time you wish, after you have written your answer. We wish you good luck in your work. Work carefully and write clearly. Now turn to Unit One, Pronunciation, and begin.

The separate units of concentration varied in length since some areas needed more coverage than others. The units logically related to each other, are covered in the Cache-Logan Spelling Text as listed below:

1. Pronunciation--In this it was pointed out that the first step in solving a spelling problem is to make certain that we have not left out letters due to poor pronunciation. For example, the "a" in the often used accidentally.

2. Homonyms

3. Silent Letters--In each case, pronunciation does not solve such problems.

4. A General Method and Mnemonics--For many words, a method including auditory, kinesthetic, visual, and association devices is necessary. Efficient memorizing is a must, and while some "memory trick" (mnemonic) devices are useful, they are not a complete answer. Some are given for interest.

5. Phonetics--It was assumed in the program that too much phonetics, especially isolated phonics, confused the student of spelling. The fact that there are many ways to spell a sound indicates that stress should be on a general memory method. However, it was decided to teach directly some commonly used phonetic facts. For example, the long a in fate, ei in

weight, and ai in pain.

6. Dictionary--The use of simple diacritical marks was explained.

7. Rules--These were related to the use of plurals, hyphens, and adding prefixes and suffixes.

8. Prefixes, Suffixes, and Roots--An introduction to word study is begun here. Artificial memory devices are not used and the meaning of word parts is stressed.

Pre-Testing

Each teacher utilized two English classes. One class received the program, and the other class was presented the same words by one of several other methods. It was hoped that the Hawthorne effect could be minimized by allowing the same teacher as a control, to use a preferred style rather than to ask them to adopt a method to be directly comparable to the rest.

No ability grouping was possible, therefore several selection tests were administered to determine the degree to which the groups were equivalent. These included the language and non-language scores of the California Test of Mental Maturity, and a pre-test in phonetics.

The initial program pre-testing consisted of a phonics test, and the S.R.A. Achievement Test section on spelling. The phonics test amounted to two different 40 item forms of a test constructed around words to be used in the program. These two forms, called "yellow" and "blue" for easy identification, served as a means of checking reliability. Both forms were given before and after the treatment period. The word sections, from which a student made his selections in constructing each total word, were coded according to a key comprising over seventy phonic elements. This

procedure was included for checking content validity.

Experimental Program

The experimental period occurred during the first semester of the 1962-'63 school year. During this period, time was planned so that the "experimental" groups used the texts twice a week for eight weeks. Those completing a unit early were allowed to do other assignments. Those students taking longer could make it up during the week.

The control or "other" groups were each taught by one of several method such as: drill, workbooks, vocabulary study, or by a combination of approaches.

Post and Transfer Testing

The post-testing included both the yellow and blue forms (IA and IB) of the Cache-Logan Phonetic Evaluation Test, and also an alternate form of the S.R.A. Achievement Test Section on spelling.

In addition to this post-testing, an 80 item transfer test was administered. This test was based on the same distribution of phonetic elements as used in the other phonetic tests. This was given only after the treatment phase. Its purpose was to determine the amount of "carry-over" there was from the post-test. This transfer test was developed from a "don't use" list. The teachers agreed to discuss these words only as they might be inadvertently encountered, but they would not be consciously included in any regular teaching procedure.

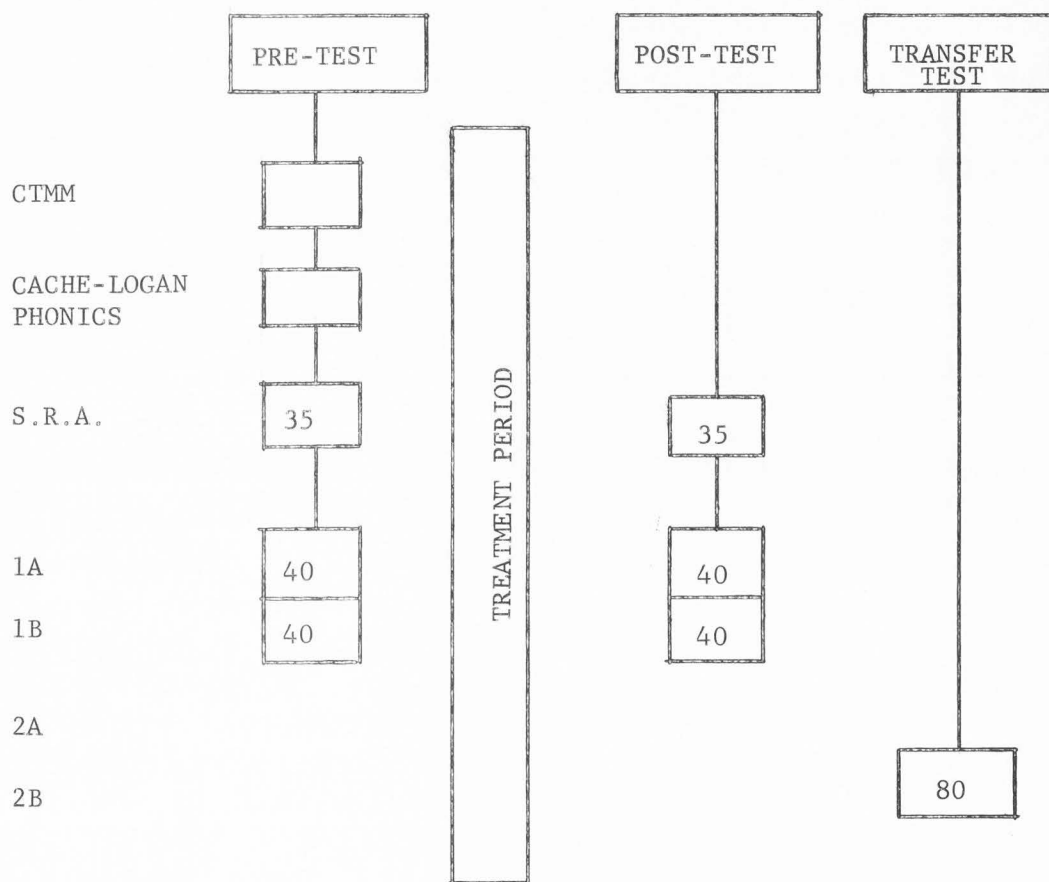


Figure 1. Cache-Logan programmed text testing design.

5. The _____ were not at home.
 Browns (69)
 Brown's (73)
 Browns' (73)
7. Only through _____ can we expect progress.
 cop (43) er (25) ashun (49)
 coop (36) ur (27) ation (47)
17. We studied the _____ hemisphere.
 hem (20) es (19) fer (40)
 him (22) is (20) fere (5)
 os (24) phere (2)
 phire (22)
36. This task will _____ all others.
 sou (38) per (25) c (4) ede (65)
 su (36) pur (27) s (7) eed (66)

Figure 2. Samples from "blue" and "yellow" forms.

RESULTS

Two tables are presented here since they are representative of the 10 comparisons which were made. Statistical work was done in cooperation with the Utah State University Statistics Laboratory, using an IBM computer. In Table 1 are the results of the analysis of variance and covariance for the results of difference scores on the "Blue" pre- and post-test. It shows the results of comparing the different scores for the two methods (program and "other"), together with teacher differences and the interaction of M (method) and T (teachers).

The most significant finding in all comparisons is that variance due to teachers was the factor showing the most significant difference. In addition, it is clear (noting the significant interaction) that some teachers were better when using the program, and some when using their own style. The program was better for some teachers and worse for others. Differences were not found when the program was compared with "other" methods.

When the original language ability factor was used in co-variance, no differences were found on the pre- and post-phonics spelling test on the selected words. (The uncorrected means favored the "other" groups rather than the program).

However, when the original language ability factor was considered in co-variance there was a significant (5 percent level) difference in favor of the program groups.

An almost identical general pattern was observed in analyses involving the alternate form "Y." Since this was an alternate form, it lends

Table 1. Pre- and post-spelling achievement (B diff. on L)

	df	$\sum x^2$	$\sum xy$	$\sum y^2$	MS y alone	F y alone	SS	MS	F
Total	425	340091.5	-2020.3	45603.7					
Teachers	9	34536.9	4152.3	5402.6	600.29	6.446	**		
Method	1	48.7	111.9	257.2	257.20	2.762	(N.S.)		
M x T	9	10753.3	-1866.1	2132.5	236.94	2.544	**		
Error	406	294752.6	-4418.4	37811.4	93.13	405	37745.17		
T & E	415	329289.5	-266.1	43214.0		414	43213.78		
Diff. due to T						9	5468.61	607.6233	6.520 **
M + E	407	294801.3	-4306.5	38068.6		406	38005.69		
Diff. due to M						1	260.52	260.52	2.795 (N.S.)
M x T + E	415	305505.9	-6284.5	39943.9		414	39814.62		
Diff. due to MxT						9	2069.45	229.9389	2.467 *

support to the validity of the testing procedure. In each case, co-variance was used with initial language ability as a reference point.

In Table 2 are the results for the transfer test. In this case, the test was composed of words illustrating the same points as made in the original list, but the words were not taught in either the program or in the "other" groups. In this table, co-variance was based on the original language ability of the groups.

Table 2 shows somewhat different results. We might infer that while direct teaching is somewhat (though not significantly) superior to the program on words actually taught, the results favor the program in a transfer situation. Students were able to use their training on the program to apply to related words in a new situation. It would be interesting to investigate further to see if certain parts of the program were more useful than others.

Note again that the individual teachers showed significant differences under analysis of variance. Neither interaction nor method showed significant differences in the transfer situation. This is probably due to the fact that the teachers concentrated on the given list rather than on transfer. However, when in co-variance the initial language ability was considered, a significant difference (5 percent level) favoring the program as well as for teachers was found. It would appear that in groups of comparable language ability the use of the program was effective in transferring to new words involving similar kinds of phonetic structure. This same pattern of results, up to the point of transfer, was seen when original phonetic skill on the pre-tests of B and Y were tested.

No sex difference appeared except for some hint that with initial language ability equated, which had favored the girls, some differences in transfer ability favored the boys.

Table 2. Transfer spelling test and language aptitude.

	df	Σx^2	Σxy	Σy^2	MS y alone	F y alone	SS	MS	F
Total	425	340091.5	81015.0	304914.7					
Teachers	9	34536.9	-5585.9	44315.5	4923.94	7.961	II		
Method	1	48.7	-316.8	2060.9	2060.90	3.332	(N.S.)		
T x M	9	10753.3	6078.2	7420.4	824.49	1.333	(N.S.)		
Error	406	294752.6	80839.5	251117.9	618.52	405	228946.68	565.3004	
T + E	415	329289.5	75253.6	295433.4		414	278235.45		
Diff. due to T						9	49288.77	5476.5300	9.688 **
M + E	407	294801.3	80522.7	253178.8		406	231184.65		
Diff. due to M						1	2237.97	2237.97	3.959 *
T x M + E	415	305505.9	86917.7	258538.3		414	233809.85		
Diff. due to TxM						9	4863.17	540.3522	0.956 (N.S.)

Six of the twenty groups were at the high school level, and 14 groups were at the junior high level. The mean scores on all tests were higher for the high school, but since the same relative differences and achievements were observed, details are not repeated here. There were some comments by the high school seniors that the material was too easy. This may suggest that except for high school remedial, the Cache-Logan programmed course is best suited for the junior high school.

CONCLUSIONS

A group of eleven English teachers met for a three month period to develop a programmed text in spelling. It was emphasized in the group discussions that the only spelling rule which really works is: there are many ways to spell a sound. As a result, pronunciation and general method were introduced first with phonics and rules followed by attention to dictionary use, prefixes, suffixes, and roots.

The program was tried for a semester along with control groups where the same words were presented in the best individual style of the teacher. Between 390-426 students participated in the various aspects of the procedure.

The "teacher style" groups did better as to gross mean scores on pre- and post-spelling achievement, but the difference was not significant. The direct attention to particular words produced somewhat greater gains. Significant differences did appear for the individual teachers, and these differences also showed significantly in interaction with method. This showed clearly for these groups that some teachers did better with the program than did other teachers.

Analysis of variance and co-variance with the original language aptitude taken into account showed that in a transfer test where new words illustrating the principles covered in the program were used, the program produced significantly better (5 percent level) results than the individual teachers. There was a significant difference observable among the teachers themselves as to which method worked best, individually.

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APPENDIX

The following pages constitute the first part of the first unit covered by the Cache-Logan programmed text:

Unit 1, Pronunciation

1. In this series on pronunciation, we want to show that careful pronunciation can help a great deal in the improvement of spelling. Of course pronunciation will not answer all the problems of correct spelling because there are many ways to spell a single sound in English. Why will pronunciation alone not solve all the problems? (Write your answer on the answer sheet, title it Unit 1, page 1, and write your name).

2. Changing pronunciations over a period of time, peculiar local pronunciation, and differences of opinion make it difficult to know what is correct. The dictionary is our guide for accepted pronunciation. Where do you go for help when you don't know how to pronounce a word?

3. We see that dictionary pronunciation is indicated in syllables. A syllable contains at least one vowel and usually its accompanying consonants. Careful _____ ? _____ of each syllable may lead to improvement in spelling.

4. The work cup has one syllable. How many syllables in cupboard?

5. Write a word which you misspell that seems to be because of the way you pronounce it.

6. One word often misspelled because of poor pronunciation is (goverment, government). Write the correct word.

7. Say the word you have written. Can you hear the n sound following the r? If so have you written government?

8. Some words are misspelled because we fail to sound all the letters. An example is the name of the room or building where books are kept. Say the word, then write it. It begins with l.

9. Check the word you have just written. Say it the way you have written it. Did it sound the same as it did when you first said it?

10. The dictionary gives us this pronunciation of the word: li'brar y. Did you write it correctly in frame 8?

-
1. On the answer sheet write the entire word for the blank: Jim is working in the chemistry lab ? ry. (Do not write on these pages).

 2. Say the word you have written. Write the word in syllables.

 3. Do you have it correctly divided into five syllables?

 4. Pronounce this word to yourself. Then write the correct spelling.
proibly probably

 5. Write the correct spelling of the word which means stillness, peacefulness. quite quiet quit

 6. The character was well ____? _____. The word to fill the blank (portrayed, potrayed) means pictured or drawn.

 7. Remember that words are pronounced in ____? ____ and every syllable contains at least one ____? _____.

 8. Think of this as you say this work softly to yourself, unusual.

 9. Write the third syllable of interpreted. Say the word to yourself. Do you hear the ret in the third syllable? If you pronounce it correctly you do.

 10. What is one of the reasons we may misspell a word?

-
1. Some people transpose or change the order of letters in words in both pronunciation and spelling. Have you ever heard anyone say children? Write the word correctly.
-
2. Do you say a. perspiration or perspiration?
b. perform or preform?
c. hundred or hunderd?
Write the correct word.
-
3. We find that some words are misspelled because letters are added. Write the correct word. hungary, hungry (desire for food)
-
4. Maintenance is often incorrectly spelled because it is mispronounced. Look at it and pronounce it as it is spelled. Write it in syllables (on the answer sheet).
-
5. How many syllables in studying? On the answer sheet, write it in syllables. You don't say the word without the y, so don't write it without the y.
-
6. Two words that present spelling problems are weather and whether. Here again pronunciation can help. A look in our dictionary will show us that most words beginning with wh are pronounced hw. You can test this by holding your hand in front of your face as you say a word beginning with wh. Do this as you say what, why, wheel, where, whether. Did you feel your breath against your hand?
-
7. Now try this as you say want, will, weather, wait. How can you tell when you are saying wh or w at the beginning of a word?
-
8. Write the correctly spelled word:
a. familiar, familar b. support, suport
c. exellent, excellent
-
9. Which of these words are correctly spelled?
a. fule, fuel b. imaganation, imagination
Did you pronounce the words in 8 and 9 before you wrote them?
-
10. What has this unit attempted to teach you about spelling?
-

Answer Sheet

Unit 1, Pronunciation

Page 1

1. Because there are many ways to spell the same sound
2. To the dictionary
3. Careful pronunciation
4. two
5. Student's choice
6. government
7. Student's answer should be "yes"
8. library
9. Answer should be "yes"
10. Answer should be "yes"

Page 2

1. laboratory
2. la bo ra to ry
3. Answer should be "yes"
4. probably
5. quiet
6. portrayed
7. syllables, vowel
8. four
9. pret. answer yes
10. We fail to sound all the letters

Page 3

1. Yes
2. pro noun ciation
3. _____
4. a. an nu al b. mis spell ed
c. sum mer
d. in ci dent al ly
5. a. success b. grammar
c. illegal d. disappear
6. Double consonants
7. dissatisfied
8. a. horrible b. happy
c. tomorrow d. intelligence
9. yes
10. _____

Page 4

1. Yes or no, children
2. a. perspiration
b. perform c. hundred
3. hungry
4. main ten ance
5. three, stud y ing
6. Yes
7. Breath is expelled for wh
8. a. familiar b. support
c. excellent
9. a. fuel b. imagination
10. It has attempted to show that careful pronunciation can help spelling.