DOCUMENT RESUME

ED 144 045 CS 003 711

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TITLE A Curriculum Analysis of an Early Reading Program: Instructional Strategies and Contingency Management.
INSTITUTION Pittsburgh Univ., Pa. Learning Research and Development Center.
SPONS AGENCY National Inst. of Education (DHEW), Washington, D.C.
REPORT NO LRDC-1977/3
PUB DATE 77
NOTE 39p.

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Beginning Reading; *Behavioral Science Research; *Contingency Management; Learning Processes; Primary Education; *Program Evaluation; Reading Instruction; *Reading Programs; *Teaching Techniques
IDENTIFIERS *New Reading System

ABSTRACT

This paper describes the results of a behavioral analysis of learning sequences used in initial instruction in the New Reading System, an early-reading curriculum. A rational analysis using behavioral categories yielded a set of strategies for teaching reading acquisition skills. Contingency management was assessed by an application of the blackout technique. Errors on progress checks were related to the content and design of the learning sequences. The results of the analysis provide data for the evaluation of the instructional products. The method used for the analysis has general application to the assessment of other instructional products. (Author)

A CURRICULUM ANALYSIS OF AN EARLY READING PROGRAM: INSTRUCTIONAL STRATEGIES AND CONTINGENCY MANAGEMENT

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The research reported herein was supported by the Learning Research and Development Center, supported in part by funds from the National Institute of Education (NIE), United States Department of Health, Education, and Welfare. The opinions expressed do not necessarily reflect the position or policy of NIE, and no official endorsement should be inferred. The author is currently at Trinity College, Washington, D. C.

Abstract

This paper describes the results of a behavioral analysis of learning sequences used in initial instruction in the New Reading System (NRS), an early reading curriculum. A rational analysis using behavioral categories yielded a set of strategies for teaching reading acquisition skills. Contingency management was assessed by an application of the blackout technique. Errors on progress checks were related to the content and design of the learning sequences. The results of the analysis provide data for the evaluation of the instructional products. The method used for the analysis has general application to the assessment of other instructional products.

A CURRICULUM ANALYSIS OF AN EARLY READING PROGRAM: INSTRUCTIONAL STRATEGIES AND CONTINGENCY MANAGEMENT

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This paper presents the results of an analysis of selected products of a structured curriculum in early reading. The purpose of the study was to provide one kind of formative evaluation of particular instructional sequences in the New Primary Grades Reading System (NRS) (Beck & Mitroff, 1972). The analysis showed what was being taught and how it was being taught. The main emphasis, however, was on how reading acquisition skills were taught in NRS. Hence, the entire thrust of the study was to make explicit the particular instructional strategies that were operative within the analyzed curriculum products. It is through the instructional strategy that learning theory enters the classroom. A major purpose of this paper has been to show the extent to which principles derived from learning theory have been incorporated into the planned learning sequences of NRS.

To further clarify the focus of the study, it may be helpful to say what it is not. It is not an analysis of reading content or subject matter. It is not an analysis of mature or even skilled reading behavior. It is an analysis of a particular instructional approach (that embodied in the NRS curriculum products) for teaching reading acquisition skills to young children of kindergarten or first-grade age level.

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The content of this study is a set of instructional strategies derived from the overall strategy or design of NRS curriculum products. These strategies are described and discussed under headings from the Skinner-Holland basic learning cycle (Holland & Doran, 1973). The strategies found in NRS have a generalizable usage. Making them explicit within the context of a specific reading acquisition curriculum shows, to a greater extent than cursory examination of the materials permits, how and why the program works. It also provides specific examples for others who would instruct in reading acquisition skills.

This paper will first give a general overview of the NRS curriculum. This includes a listing of the instructional components or products available to teacher and/or student. In addition, the organizational structure of the materials is briefly described. Then, the specific products which are the subject of this analysis are identified. As part of the general overview, the limitations of a Skinner-Holland approach to curriculum analysis are discussed. The design of the study is explained briefly.

The second section of this paper presents the basic findings of the analysis. These are strategies of instruction. They are presented under headings which roughly coincide with the Skinnerian learning cycle (Skinner, 1968): stimulus control, student responses, promoting memory, evaluation of responses, and contingency management. The final section of this paper presents some conclusions based on the findings and some implications derived from this particular type of study.

General Overview

Description of the Curriculum

The New Primary Grades Reading System (NRS) is an experimental reading acquisition program produced at the Learning Research and Development Center of the University of Pittsburgh. The rationale and design of the curriculum have been presented in another paper (Beck &

Mitroff, 1972). The instructional components of NRS consist of the following: a teacher's manual for each level; cassette tapes for each lesson, a workbook for each level or part of a level; blending booklets, letter cards, and pocket charts; story books, tests, games, and manipulables, and, finally, alternative teaching strategies. One of the unique features of NRS is the design of the system, with each component containing specified content and skills that are related to and integrated with other components along the continuum of instruction. Figure 1 highlights the essential features of NRS.

The general approach to reading in NRS is a code-breaking one. Decoding or word attack skills are specifically taught. If a word has not yet become a part of the child's recognition vocabulary, the word may be attacked in its separate letter parts and so decoded.

Within NRS, there are four strands or patterns of progression. Three of these--the decoding strand, the comprehension strand, and the self-management strand--move in a kind of intertwining sequence. The fourth strand, that of alternative strategies, is available for children who cannot respond successfully in the planned progression of lessons and reviews.

The curriculum is organized into approximately 16 levels. The first two levels contain 25 teacher-led lessons. Each level thereafter contains about 10 cassette-led lessons. Within each level, there is provision for both horizontal and vertical movement. The vertical movement is termed the prescriptive category (see Figure 2). The horizontal movement includes a number of story books, games, and manipulables that the child is encouraged but not required to try.

This study centers on the instructional sequence that comprises the vertical progression of the curriculum as this is set forth in the linear set of behavioral objectives embodied in lesson sequences. The segment of interest is the vertical progression and the initial instruction within this progression (i.e., the first time a particular type of

DOMAIN	First three years of reading instruction
POPULATION	City children in U.S.A.
SPECIAL FEATURE	Individualized in: ——rate: prescription and maintenance ——routes: selection ——pupil: choice and alternate paths
STRUCTURE	16 Levels: 10 sequences per Level
FUNCTION	To teach new skills To maintain old skills To build fluency To permit "discovery" learning
SCOPE	Reading in its broadest sense "the perception and comprehension of written messages in a manner paralleling that of the corresponding spoken messages" (Carroll, 1964)
APPROACH	Code-breaking. synthetic phonics analytic phonics linguistic patterns contextual presentation of linguistic elements

NRS is an individualized adaptive system in a student centered environment *The Rationale and Design of a Primary Grades Reading System* (Beck & Mitroff, 1972).

Figure 1 New Reading System.

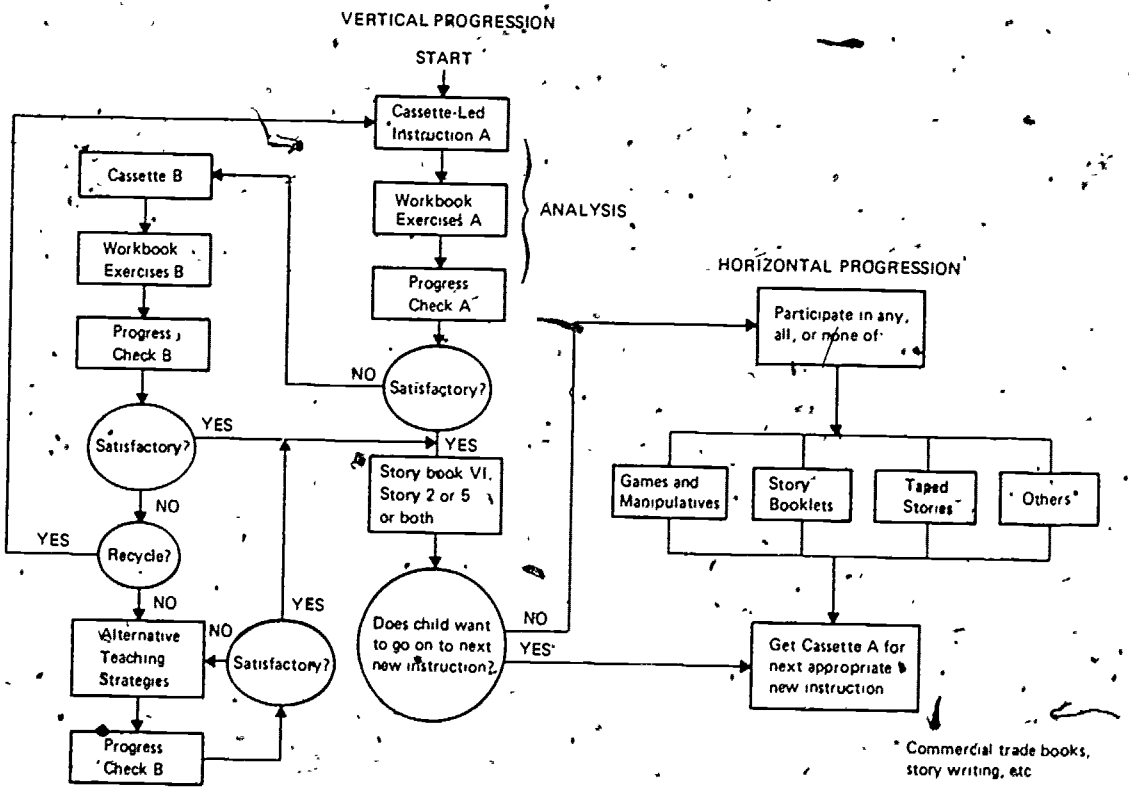


Figure 2. Flow chart of the instructional sequence of NRS (From Beck & Mitroff, 1972.)

learning is introduced). Workbook pages are studied only as follow-up and maintenance of skills that were taught in initial instruction. (See bracketed section labeled Analysis in Figure 2.) The materials analyzed are the scripts for teacher-led lessons, response sheets with tape scripts for cassette-led lessons, and workbook follow-up pages.

Limitations of the Analysis

The limitations of a Skinner-Holland approach (Holland & Doran, 1973) to curriculum analysis are basically the same as those of a more general Skinnerian approach (Skinner, 1953) to behavior. Within the Skinner-Holland model, instruction is viewed as essentially a management process: The task is to control the conditions of learning by applying the basic learning principle. This principle can be stated thus: Arrange for the learner to make the appropriate response so that it can be reinforced. Analysis, according to this model, calls for the identification of the three terms of the contingency (viz., the stimulus, the response, and the reinforcement). This three-term contingency or operant then becomes the repeatable unit to be used in the construction of replicable sequences of curriculum. The analysis is thus limited to a clear identification of stimuli, responses, and contingencies for reinforcement of critical responses. Furthermore, only curriculum products that have adhered to this Skinnerian design, at least implicitly, should be subjected to this kind of analysis.

Both the design and the analysis of the design are based on the assumption that laboratory variables can be translated into the classroom setting and still retain enough validity to facilitate learning and to operationalize the principles of learning theory. This same assumption requires at least some degree of individualization in the design of the curriculum materials.

Another assumption of this approach to the design and analysis of curricula is that learning is the product of the consequences of behavior.

Related to this is the contention that errors are punishing and should, therefore, be minimized in the plan of instruction. Error rates do, however, give data on covert student responses. In accordance with these assumptions, this type of curriculum analysis will place emphasis on the contingencies built into the program. The analysis will also consider data on student errors as giving access to information on student learning. The mode of correction of errors also merits attention in the analysis.

Finally, the type of analysis used in this study assumes that there is a definite "body of knowledge" to be organized. In this way, instruction can be objective, precise, and efficient. The rate of learning for individuals is maximized. While this analysis does not deal with the issue of individual student rates, it does extract from the materials a structure of the skills of reading acquisition.

A basic limitation of the Skinner-Holland approach to the analysis of curricula is that no use is made of cognitive models of learning. The work on meaningful verbal learning or in psycholinguistics, memory, and perception cannot be utilized. Knowedge is equated with behavior and there is no attempt made to describe events in the conceptual system. The variables studied are limited to programming variables--that is, input or stimuli, output or responses, and straightforward relationships between and among these. The Skinner-Holland method concentrates on shaping behavior by a gradual progression and successive approximations, prompting and fading of prompts, and active responding as evidence of proper discriminative behavior. These constitute the conditions of learning.

Design of the Study

The study is designed on the assumption that inherent in the materials of NRS is a prescriptive theory of instruction for reading acquisition. In constructing the components of a curriculum according

to a predetermined plan, there are at least four elements to be considered: (a) the structure of the skill to be acquired (the basic tasks of reading acquisition), (b) the entry behavior of the learner, (c) the instructional procedures, and (d) assessment of mastery behavior (Glaser, 1976). In identifying the structure of reading acquisition skills as they appear in NRS, the hierarchy for decoding produced by Gagné (1965) serves as a model. The reading acquisition models reported in the Targeted Research and Development Project on Reading (Williams, 1973) also serve as aids to identify the small tasks of reading acquisition in NRS.

The task analysis for NRS has been divided into two parts: decoding tasks and comprehension tasks (see Figure 3). Entry behavior of the learner has been identified as the language skills possessed by a 5- or 6-year-old child. The types of tasks designed for the instructional sequences make some assumptions about the skills the child already has and those he needs to be taught. This study has accepted those assumptions.

At the end of the study, some discussion is given to the results of the progress checks. This is not a statistical or quantitative measure of results. It is descriptive and its purpose is to point out the degree of success achieved by the learners using the mode of assessment built into the design of the materials.

Main emphasis. The main emphasis of this study is on the third essential element for an instructional design, the instructional procedures or strategies. The prescriptive principles or instructional strategies identified are those derived from the Skinner-Holland learning model. These are strategies related to stimuli, strategies related to student response, and strategies for contingency management, including sequencing.

Selection of curriculum components. Curriculum materials to be analyzed were selected only from the vertical progression (i.e.,

DECODING (graphemic units)

1. Produce the sound that corresponds to the stimulus: a single letter, a digraph, a blend, a diphthong
2. Identify graphemic units by sound
3. Discriminate graphemic units by sound
4. Discriminate spelling patterns as graphemic units
5. Blend sounds into words
6. Identify words by sound
7. Discriminate words by sight
8. Discriminate various units presented simultaneously
9. Discriminate the relevant graphemic stimulus
10. Generalize among graphemic units

COMPREHENSION (words and word groups)

1. Label: identify words by picture; transfer meaning from picture to word
2. Identify units of meaning by sight: words, phrases, sentences, paragraphs
3. Discriminate various units of meaning
4. Generalize units of meaning: by sound to units of meaning by sight
5. Relate oral language patterns and printed structural groupings

Elementary comprehension is on the level of syntax and surface structure of language.

The structure of the discipline of reading is a set of relationships between spoken and written language.

Figure 3. Task analysis for NRS.

either teacher-led or cassette-led lessons; see Figure 2). From these lessons were selected only those where a strategy was employed for the first time or where new content required either new strategies or alterations in strategies already employed. Figure 4 gives an outline of the decoding materials in terms of curriculum content. Figure 5 shows the specific letter-sound correspondences in order of introduction into the program. These materials form what the designer has termed the decoding strand of NRS.

In the analysis of the comprehension strand of NRS, selection of materials was limited to: (a) a single lesson from the workbook follow-up pages, (b) comprehension format types on first occurrence, and (c) 100 randomly selected workbook pages. The single-lesson analysis showed strategies for facilitating independent comprehension immediately following instruction. Study of the various comprehension formats showed how both variety and gradual progression in difficulty were incorporated into the curriculum. Selection of 100 workbook pages was intended to give a more general indication of the degree of attention to text that the materials of NRS required from the learner.

Procedures of analysis. Once the materials had been selected and organized as curriculum products, each segment was then analyzed in detail. Four prescriptive elements were identified in each instructional sequence analyzed: (a) entry behavior, (b) mastery behavior (the reading acquisition task), (c) instructional procedure, and (d) assessment of mastery. The third element, instructional procedure (strategies), received intensive analysis for each segment. The Skinner-Holland model (Holland & Doran, 1973) was applied to the procedural element of each segment of the curriculum selected for analysis. In this way, strategies related to stimulus, to response, and to sequencing were made explicit.

The materials already selected in accordance with criteria based on curriculum organization were further categorized by the Skinner-

Emphasis on Decoding Behavior

Textual Objective	Level	Content and/or Process	Instructional Product
Read regular words	I	1 11 symbol/sound correspondences	Letter/sound correspondence in Basic Script #1
		2. algorithm	Blending in Basic Script #2, #3, and #4
Read regular words, sight words, phrases, sentences	II	3 symbol/sound generalization for *ee* and *ea*	Portion of Lesson 8, Level II.
		4 Fading the algorithm	Basic Scripts #3, and #4
Read spelling patterns (larger chunks)	III	5. symbol/sound correspondence *ch*	Presentation format and script for cassette-led Lesson 3–1–A
		6. et, it, etc. spelling patterns	Lesson 3–4–A
Read long and short vowels in words	VI	7. long and short vowels, viz., / Fading diacritical marks	Cassette-led Lesson 6–2–A

Figure 4. Segments of NRS selected for analysis from the vertical progression of programmed objectives Emphasis on decoding behavior.

Level I	Level III	Level IV	Level V	Level VI
1 a,m,s,t,c	1 ch	1 d,D	1 v	1 wh
2 –	2 o	2 u	2 es	2 –
3 –	3 l	3 –	3 th	3 y/funny
4 –	4 patterns et, it, ot, ap, ip, op	4 k	4 ar	4 –
5 sh	5 –	5 –	5 y/try	5 –
6 n	6 r	6 –	6 –	6 j
7 –	7 –	7 – all	7 ō	7 ay, ai
8 –	8 g	8 w	8 er, ur, ir	8 x
9 e	9 h	9 ı	9 ū	9 patterns
10 –	10 –	10 –	10 –	10 –
11 b	11 –	11 –		
12 ā, ē	(6)	(5)	(5)	(4)

Level II
1 S, T, M
2 c, M, N
3 –
4 –
5 –
6 –
7 f
8 ee, ea
9 –
10 i
11 –
12 –
13 ss, ff, tt, ing
14 p
15 patterns
16 – (5)

1. Placement of b and d at a distance
2. Introduction of p but not q
3. Placement of f and v at a distance
4. Placement L/S correspondence in Level I and 2 in Level II
5. Only 5 or 6 per 10 or 11 lessons
6. Alternate single L/S correspondence with digraphs, blends, diphthongs or patterns
7. Does not introduce all vowels at once, or all short or all long vowels at once.

Note. Numbers in parentheses indicate new letter/sound correspondences included at each level.

SEQUENCING OF NEW INSTRUCTIONAL STIMULI *PRESCRIPTIVE*

Figure 5. Sequence of symbol/sound correspondences for Levels I – VI in NRS.

Holland model according to response types. This categorization is shown in Figure 6. It was used to group the materials of the decoding strand of NRS. Responses for comprehension were categorized into two types: word scanning and textual scanning. Comparisons were made with several comprehension taxonomies (Auerbach, 1971, Carroll, 1972, Davis, 1968; Reading Objectives, 1970). A task analysis of NRS was given in Figure 3.

The application of the Skinner-Holland model to the analysis of instructional procedures implies that the materials have been structured or programmed. Certain principles of learning theory have been applied. The variables derived from that theory should have assumed some importance in the design of the materials.

A programming variable is that aspect of a learning sequence that may be deliberately manipulated by the designer. The recognition of the use and function of programming variables is what gives elegance to the design of instruction. The Skinner-Holland model places emphasis upon the stimulus, the response, and the reinforcement. Within this context, these programming variables were of interest: (a) eliciting and maintaining attention, (b) prompting, (c) response availability, (d) facilitation or interference in memory, (e) mediation techniques, (f) page and format layouts, and (g) the use of two channels for stimulus input. These particular variables are generalizable across a variety of content. In this analysis, they were examined with reference to reading content structured for acquisition skills.

The results of the analysis are of three kinds. First are the strategies or principles of instruction for reading acquisition. These are derived from a rational analysis of both content and process for reading as these show forth in the instructional materials. The second is a study of attention to text in NRS as determined by an application

1 Establishing control by a new stimulus: a printed grapheme for a spoken sound
Analysis of Basic Script =1

2 Establishing a new response pattern (repertoire) joining strings of graphemic units to form words
Analysis of Basic Scripts =2, =3, and =4

3 Establishing rote associations
In this case, learning sight words
Analysis of appropriate Lessons of Level II

4 Establishing stimulus generalization
Making the same response to different graphemic stimuli.
Analysis of the teacher led portion of Lesson 8; Level II

5 Establishing an abstraction
concept formation, recognition of all instances of a class.
Generalizing across Levels of NRS through previously analyzed sequences (see Figure 4).

Figure 6. Types of tasks to be studied in NRS

of the blackout technique. The third is a study of the materials in the light of student errors on progress checks.

While all three types of results in this study are specific to reading, the procedures used have more general application to other content areas. According to the nature of the discipline, the same general process could be adopted. What follows is a brief reporting of the results of this study. A more detailed treatment appears in a doctoral dissertation by McCormick (1975).

Results of the Analysis

Instructional Strategies in NRS

Structure. The analysis of this program indicates that the structure of the discipline of learning to read is a set of relationships (correspondences) between printed textual units and spoken language patterns. The size of the unit of processing is treated as a variable feature. The unit for decoding may vary from a single letter to a spelling pattern of three or four letters. The unit for comprehension may be as small as a single word or as large as an entire sentence. By presenting the elements for decoding both in isolation and in context, the program teaches that there is no one single unit either for decoding or for comprehension. By consistent variation of the use of these units either in isolation or in context, the learner is taught this essential concept, which forms the basis for learning-to-read skills: that he must deal with a variety of graphemic and syntactic units in order to read well.

The basic reading acquisition task is the transfer from the use of exclusively auditory symbols for language comprehension to the use of visual symbols of language for comprehension of the same message. In the acquisition stages, the reading of words must be accompanied by the hearing of words. The concept of a word is taught by induction

when the key phrase, "The word is _____," completes the procedures of the blending algorithm. Likewise, in the algorithm, some steps needed early in the process are dropped out later. All of this is characteristic of the teaching of acquisition skills for reading in NRS.

Mastery behavior. Mastery behavior is stated in terms of Carroll's (1964) definition of reading: "the perception and comprehension of written messages in a manner paralleling that of the corresponding spoken messages" (p. 336). Mastery behavior in NRS is a relative term. Within the first six levels of NRS, mastery behavior for decoding consists of the unprompted application of the skills contained in the blending algorithm. Comprehension mastery includes the use of a recognition vocabulary within the context of various types of syntactic patterns.

Entry behavior. Upon entering the New Reading System (NRS), the learner is presumed to have the particular skills associated with competence in oral language at age five or six. He is not presumed to have the ability to write. Moreover, any reading acquisition task that the child is expected to perform independently is first presented in instruction. Among types of tasks taught in the decoding strand of NRS is the segmentation of words into their component parts. This is an important reading skill that cannot be presumed to be a part of the learner's entering behavior. The use of imitation (modeling) in NRS takes advantage of the skills already in the learner's repertoire.

Sequencing. As the lessons progress, units (tasks) that were once quite distinct become grouped into larger units. This is a principle running through the entire program. Its application is evident both in the selection of stimuli for presentation to the learner and in the types of responses that are shaped successively throughout the sequences.

Strategies Related to the Skinner-Holland Model

Stimuli. The discriminative stimuli for the decoding strand are graphemic units of various sizes (see Figure 5). For comprehension, the discriminative stimuli are words and various syntactic patterns. Questions are used in NRS to focus the attention of the learner on specific syntactic patterns. The observing and instructional stimuli used in modeling are already in the learner's behavioral repertoire. These stimuli aid the learner in discriminating the new graphemic stimulus, which is the object of the instructional sequence. In NRS, ample use is made of this strategy.

The basic strategy for the selection of graphemic stimuli in NRS is to present to the learner only those units that do follow the alphabetic principle. This keeps consistency high. However, inconsistencies are also introduced as early as Level I so as to alert the learner to the fact that they do exist.

Discrimination of stimuli. Various strategies are employed for the presentation of stimuli. In early learning, stimulus pairing is used. The oral stimulus is paired with the graphemic representation and thus the learner is guided to give the same response to a new stimulus. Also, in the beginning, a gross stimulus control is established. This is done by presenting the graphemic unit in isolation. Once the learner can identify the discriminative stimulus (S^D), control is sharpened by presenting the S^D in various contexts. Another strategy for sharpening stimulus control is matching to sample. This is an easier task than presenting words containing the S^D alone or where the S^D occurs in varying parts of the word. These same techniques are applied in the presentation of syntactic units.

The use of contrast is employed as a strategy in NRS. The teacher (voice on the tape) pronounces words (e.g., mat, mate) before asking the child to read them. Another strategy employed in NRS is

the introduction of new elements without explicit instruction. For example, the size of the type is gradually made smaller but no attention is drawn to it.

Examination of the response pages shows that generally there is a pattern of easy to diffitult. The progression is from gross discrimination to sharper discrimination. Exceptions to these general procedures seem to occur for the sake of relief from a steady stream of difficult and attention-demanding tasks.

Still another technique for stimulus presentation is the combination of previously learned graphemes into spelling patterns. New and larger units formed of familiar stimuli are created. Thus, varied examples of the concept of graphemic unit are provided.

Supporting stimuli. In addition to the S^D, the object of the instruction in the learning sequence, there are numerous supporting stimuli. The function of these varied prompts is to direct the attention of the learner to the S^D and to enable him to produce the correct response. Basically, prompts are either formal or thematic. Formal prompts provide information about the form of an expected response. In NRS, the response format itself serves as a formal prompt. In addition, within the response formats these examples of formal prompts occur: (a) showing part of a word for completion, (b) use of rhymes, and (c) the underlining of relevant graphemes. The voice on the tape can also deliver formal prompts, particularly in the form of rhymes. Thematic prompts depend on meaningful associations to make it more likely that the student will give the expected responses. These occur in NRS especially through the use of pictures and also through verbal elaborations that the voice on the tape gives about words. In particular, the prompts are faded consistently through lesson sequences and also through the lessons of a level, and final responses are unprompted and independent.

Responses in NRS. Written responses, though limited to markings of various types, should be indications that some covert response has already occurred. Responding in NRS must be quite frequent. The workbook pages, which follow up the instruction of the teacher or cassette tape, perform the function of providing rehearsal of new skills taught in initial instruction.

Critical responses. The critical response must be identified for every learning sequence. It is only upon the occurrence of this response and its consequent reinforcement that learning can be guaranteed (Holland, 1965). In the beginning of reading instruction for decoding, the learner actually knows the responses he needs to produce. What he needs to learn is how and when to use these responses. The strategies used to elicit these known responses in NRS are verbal instructions and demonstration of the desired response. Once a new relationship is learned, it must be practiced in a variety of contexts and reviewed periodically.

Another strategy used in NRS is derived from the fact that there are classes of responses of which a single response may be one member. This is important for the shaping of correct phoneme responses. An approximation close enough to the sound modeled by the teacher should be accepted as a correct response because it is a member of the general class. This principle also takes into account the variations in inflection in different parts of the country and the existence of dialects of English. Accepting a response as a member of a class of appropriate responses is an important function of the instruction.

The strategies for eliciting the critical decoding responses are: (a) making successive approximations, (b) shaping the responses by differential reinforcement and by gradually raising the criterion of acceptable behavior, and finally (c) fading prompts until the response is produced independently. With reference to responses, the design must indicate not only the specific response but also the circumstances under

which it is to be elicited, as well as when there is to be a change from one type of response to another. For example, in NRS there is a shift in the letter/sound sequence from an imitative auditory response to a response to a graphemic stimulus.

Acquisition of associations. The fundamental inferred response throughout the decoding strand is the simple association. The number of associations to be learned at one time must be limited, and easily confused associations should be kept at a distance. The curriculum content shown in Figure 4 indicates that this is so. Particularly notable is the placement of b in Level I and of d in a level beyond Level VI. Also noteworthy is the introduction of only one sound for a given grapheme at a time, the use of diacritical marks as a distinguishing characteristic for vowels that would otherwise look alike, and the careful sequencing to remove the diacritical marks in later lessons. All of these measures serve to prevent confusion of associations.

The acquisition of new associations is also prompted by efforts to employ previously learned associations in the learner's repertoire. An example of this is the introduction in Level I of a digraph (an important graphemic concept), which has a very familiar and, it seems, attractive sound for children: /sh/. In the comprehension strand, the voice on the tape often elaborates about a new word, using familiar associations in order to facilitate memory of the word.

In order to demonstrate the acquisition of an association, the learner must make more than a copying response. In NRS, responses are required that imply a discrimination of the stimulus. Sounds produced early in the learning sequence by mere imitation are later required to be produced both independently and when the corresponding grapheme is presented in any order of occurrence.

Discriminations and generalizations. Discriminations should be prompted, practiced, and introduced with contrast. In auditory discrimination, imitation (as in the blending algorithm) is the learner's

way of showing that he has detected the distinctive features of the response. Simple generalizations on the part of the learner can be facilitated by requiring the same response to different stimuli. A more subtle generalization in learning to read is the production of a unique sound upon the presentation of a graphemic unit of whatever size. This type of generalization is called for throughout the cassette tape lessons. The same type of generalization must be made in decoding the various examples of syntactic units. This occurs more frequently in the workbook pages. Demonstration by decoding correctly is the means of determining whether the learner has acquired the concept. Presenting decoding and comprehension units in context (e.g., in "stories") enables the learner to use negative information. Negative information in the context of concept formation means the irrelevant features and negative examples of the concept. A section of continuous prose compels the reader to generalize with reference to the concepts of graphemic unit and syntactic unit by introducing features irrelevant to these concepts for any specific unit he has selected for decoding.

In addition to concept formation, the program provides for concept utilization by limiting vocabulary mostly to words already familiar to the child. The algorithm provides the child with a set of things to do to solve a problem. It also calls on skills already possessed by the learner but shows a new way of combining these skills.

Promoting memory. Still another class of strategies in NRS are those that promote memory. Placing highly similar stimuli at a distance, limiting the size of a list to be learned, and providing for practice immediately after instruction are some of the ways used in NRS to facilitate memory. Others are immediate reinforcement for correct responses and verbal instructions used so consistently that they may become self-prompts for the learner. Efforts to keep errors to a minimum and to build a large recognition vocabulary indicate attention to facilitation of memory.

A number of strategies already mentioned have relevance for facilitation of memory. Rehearsal is known to be an important modifier of rate of learning and degree of retention (Glaser, 1969). The workbook pages provide rehearsal and thus serve the retrieval stages in memory. The length of the span of immediate memory increases when the material is familiar and has been in some way organized by previous learning (Gagné, 1970). This same principle is applied in the blending algorithm. Since about 30% of the variance in comprehension achievement can be due to memory for word meaning (Davis, 1968), using words whose meaning is already familiar to most 5- or 6-year-olds is an important strategy. Finally, the recoding provided by the incorporation of old responses into new should facilitate memory. Once material is recoded, it may resist competition very strongly (Deese, 1958). Contrast in discrimination learning helps to overcome the effects of interference (Gagné, 1970).

Evaluation of responses. By three-term contingency is meant the relationship between the stimulus, the response, and the reinforcement. This relationship should be planned in such a way that the reinforcement is dependent or contingent upon the production of the correct response to the stimulus presented. Reinforcement should always have reference to the specific behavior to be acquired.

To complete the three-term contingency, once a response has been emitted, some decision must be made as to its correctness. The response must be "sensed" or evaluated. The ideal way to do this is on a one-to-one basis between teacher and student. However, since this is not possible in the typical school situation, the teacher must be very aware of the possibility of interference from the wrong responses of other children in the group. Early learning requires more continuous reinforcement than later learning, as in the early sequences of NRS. The critical final independent response for each sequence is an individual response within the group instruction.

When cassette-led instruction is used, provision must be made for the immediate evaluation to be self-evaluation. In cassette-led instruction, responses can only be corrected or confirmed. The program should be very effective provided that the learner's difficulties have been anticipated and the voice on the tape can give the kind of feedback that the learner needs. Only empirical validation can assure that this is so. The rational analysis showed that great attention had been given to the strategy of providing appropriate feedback to the learner on the tape.

Use of reinforcement. As learning progresses, intermittent reinforcement will suffice to keep the learner moving through a sequence. Not every answer need be confirmed and/or praised. One technique in sequencing is to try to end with both independent and correct responses. However, evaluation or "sensing" of the learner's response is the weakest part of the design of NRS.

Reinforcement tends to be a rather individualistic matter. However, in designing instruction, it is possible to generalize to some degree concerning the kinds of things a particular group of learners might find reinforcing. Types of reinforcement generally used throughout the program are as follows: (a) artistic and pleasing arrangements of pages, (b) immediate feedback or knowledge of results, and (c) the possibility for a high level of success, depending on how well the program estimates what the learner can do. Small steps are reinforced. The learner can control his own behavior by turning the tape recorder on and off and deciding how long to stay on a particular frame. The program makes use of "silly" sentences, jokes, riddles, puzzles, etc. The movement from frame to frame and from workbook to workbook can be reinforcing.

In summary, the program is not highly responsive to the errors of the individual. Individualization is achieved by generalizing about the capabilities of learners of this age who have no previous training

in reading skills. Individualization depends also to a great extent on the teacher's judgment and the teacher's ability to fit the program to the learner. Examination of individual students' progress through the levels of NRS indicated that, except for variations in initial starting points in the program, not much variation was evidenced in the routes through the prescribed lessons. Some learners did, of course, skip review sequences. Management for individualization occurred generally at the progress checks. Ideally, this kind of evaluation could happen all through the sequences. The materials in themselves are not responsive to individual errors of the learner. The nature of the program makes it imperative that teachers have very specific training in evaluating the range of acceptable oral decoding responses within the early sequences.

Contingency Management

An overall analysis of the program can be made in terms of contingency management. Generally, the individual sequences as well as the cumulative sequences have been planned in such a way that, given the presentation of the appropriate stimulus, the correct response is elicited and then reinforced. Generally, reinforcement is in the form of feedback, which, if all has gone as planned, tells the learner that he is correct. What the feedback really tells is the correct response, and then it conditionally offers praise to the learner if he has responded with the correct answer.

In NRS, contingencies are first established for small "steps." Active and specified responses are detailed in the letter-sound sequence. Later some steps are faded and this sequence itself is incorporated into the blending algorithm. Then some of these steps are faded. Thus, a kind of pattern is established.

If the learner can merely guess, the contingencies have not been planned properly. In the letter-sound sequence, there are two possible

interferences with the proper sequencing of contingencies. One is the possibility of the learner not responding correctly and yet being reinforced by the teacher who failed to detect his wrong response because of group answering. Another confounding of contingencies could occur if the child was not ready to move from the mouthing cue to the finger cue. He could still be looking at the teacher's mouth when he should be looking at the finger pointing to the letter, which has now been removed from in front of the teacher's face and held at arm's length. This can be avoided if the teacher is careful in making the transition from cue to cue, and if s/he is careful to administer cues in such a way that the learner does not become distracted and so fail to look at the letter whose sound is being cued.

In good instruction, interesting things should happen after the student has read a page or listened or looked with care (Skinner, 1968). When this does occur, the materials are really self-pacing. Some of the management strategies in NRS assume that reading behavior will become self-reinforcing. This is the rationale behind the gradual withdrawal of external rewards like praise, especially on the cassettes.

In planning for contingency management, not only must the critical response be identified, but also the other responses leading up to the production of the critical response. Moreover, consistency of demands makes it easier for the learner to sense the contingencies. In decoding sequences, the contingency could be articulated to the learner thus: If you correctly imitate this sound and then use it to identify the correct grapheme or graphemic unit, you will be rewarded (praised). Pointing, looking, and saying must occur simultaneously. This is in order to fulfill the condition of continuity for forming the association. In the comprehension sequences, grammar rules determine the contingencies for the successful demonstration of knowledge of the syntax of the language. If the learner is praised only for the predetermined behavior, then the contingency will be established and

the consequent reward should increase the probability of correct responding in the future. For the most part, this is the kind of planning that is evidenced in the materials of NRS.

Blackout technique. Analysis of the contingent relationships built into the instructional materials was made by using the blackout technique (Holland, 1967). This is a method for measuring the extent to which the responses in a self-instructional program are dependent on the content (inferred responses) of the program. The blackout "ratio" is the percentage of the program that can be deleted without influencing error rate. Research with the blackout technique has indicated that making overt responses facilitates learning, provided that these responses are contingent upon the critical content of the lesson (Holland, 1967). By critical content is meant one or more tasks identified in the task analysis. In a well-designed lesson, the student can respond correctly when and only when his responses demonstrate that he has made the critical inferred response to the stimuli presented in the lesson. In other words, the learner should make the right response for the right reason.

The requirement for overt responses should provide a way of monitoring the covert responses. In order to mark the correct word or picture, the learner must have had to read all or almost all of the words in a given format (frame). In the blackout technique, the word is taken as the unit of analysis. In the completion of each frame, the learner should be able to produce the correct response by reading the text. The overall task should be one identified in the task analysis (e.g., identifying phrases within the context of a sentence).

In this study of NRS, the blackout technique was applied to two different sets of workbook selections. First, each new response format was selected at its first occurrence. The blackout ratio for these

frames (rather than full pages, which sometimes included several frames) was estimated by a single judge. Of the 32 frames thus selected, 16 were judged to have no blackout at all. This means that all of the text had to be read by the student in order to respond as specified. The remaining frames had blackout ratios ranging from 3% to 66+%. If the purpose of the frame at first occurrence is simply to accustom the learner to a certain mode of response, then possibly a higher blackout could be tolerated. However, if the intent is to have the student read every word of the text, then some revision of pages with high blackout ratios is necessary. It should be noted that the ratio reported here is simply a judgment of one rater. No attempt was made in this analysis to validate the judgment with other raters. No attempt was made to ascertain whether the designer had purposely introduced frames with a high blackout ratio at particular places.

Progress Checks

A low blackout ratio indicates that the material is well programmed provided that the error rate is low. Assuming that critical content is being programmed, the errors of students can then be analyzed to see what elements of content presented the greatest difficulty. Such difficulty could indicate that perhaps the functional units for the program are too small for the learners. Lack of errors could also indicate that the learners have mastered the critical content through valid instructional techniques. Once low error rate has been established, further analysis is necessary to determine what the low error rate means for the learners.

Data on errors from the progress checks do not provide the same kind of information as data on errors from an application of the blackout technique. In order to provide blackout ratio information, errors made on the instructional sequences themselves would have to be tabulated and analyzed after the manner used by Holland (1967). The error

data from the progress checks simply show how many learners retained an acceptable number (as judged by the designer) of letter-sound discriminations, words, and syntactic patterns at the end of a level or lesson in NRS.

The sample for which this information is reported consisted of four classrooms with a total of 74 children, all in Grade 1. Each classroom had a different teacher. The data consist of errors on progress checks for each of the Levels I through VI of NRS. There is one progress check each for the end of Level I and of Level II. Thereafter, there is a progress check for each lesson within each level and errors are reported in that manner.

The analysis of the data from the progress checks showed a high level of success for most of the learners. The greatest number of errors occurred where successive consonants had to be blended. This is a difficult skill and some errors should be expected here. In some cases, the errors of only a few children accounted for all of the errors at a given lesson. The fewest errors occurred at the upper levels where the most rapid learners were concentrated.

An interesting circumstance to note is that even with the materials very carefully structured, the teachers still made a difference in the success of their students. One teacher apparently tried to analyze the errors of her students and made notations on their progress checks. This same teacher made use of the prompt "blend" when children were having difficulty decoding a word. This technique brought success to students who might otherwise have failed. The unequal progress of students by classroom is evident in the data displayed in Figures 7 and 8. Further investigation would be necessary to verify that differences in student groups by classroom are related to differences in teachers' strategies within the program.

The degree of individualization by rate of progress through the materials is shown in Figures 7 and 8. Figure 7 shows the distribution

of students over the levels of NRS at the end of Grade 1. Figure 8 shows the location of the individual students by lessons within these levels. Figure 9 shows the rate of progress through the levels of NRS for six students selected because of the different patterns they followed.

——For the task analysis employed in the design of NRS to be clearly shown to be adequate and effective for the instruction of the selected 5- and 6-year-old population, what is needed is a validation of the task analysis within each lesson sequence. Using a small number of students, the blackout technique could be determined by empirical investigation for the actual instructional sequence (not the progress checks). From these results, it could be determined whether some of the "steps" are too large or too small for most of the students for whom NRS has been designed.

Further analysis of lesson sequences might also be done to determine what material is redundant for the learners who can progress rapidly (viz., those who arrived at Level VIII in June, when this study was done). Perhaps as the learners spread out and the concepts of graphemic unit and of syntactic unit are acquired, still more variety is needed in the types of sequences presented to the learners. The size of the "steps" could depend on the speed with which the learner can acquire these two basic concepts needed to become skillful in decoding and in early comprehension tasks.

A carefully validated empirical analysis should be made of the selected response formats used in this study and also of a sample of randomly selected workbook pages. In the present rational analysis, even though estimates of the degree of blackout were made, more precise information is needed. Some attention should also be given to the mode of correction of errors within the sequences. Empirical data would give accurate information on the degree of attention to text that is required and elicited from learners in NRS.

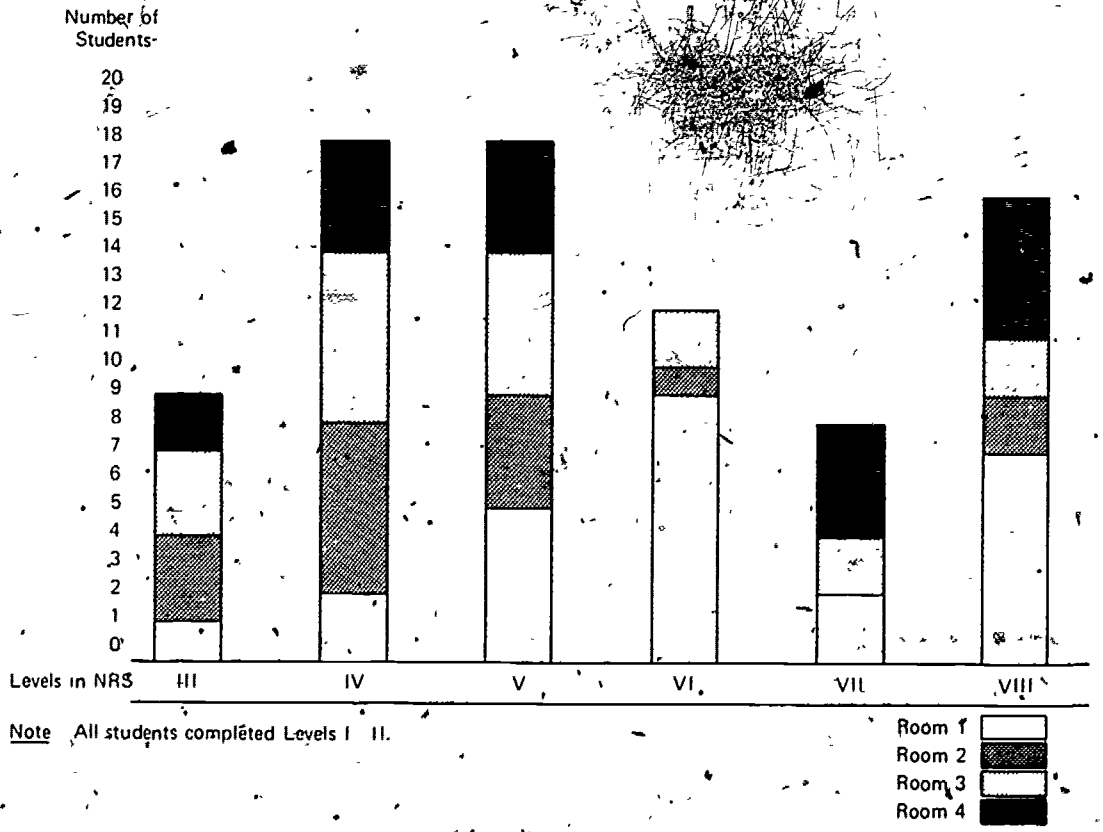


Figure 7. Distribution of students throughout levels of NRS at the end of Grade 1, June 1, 1974.

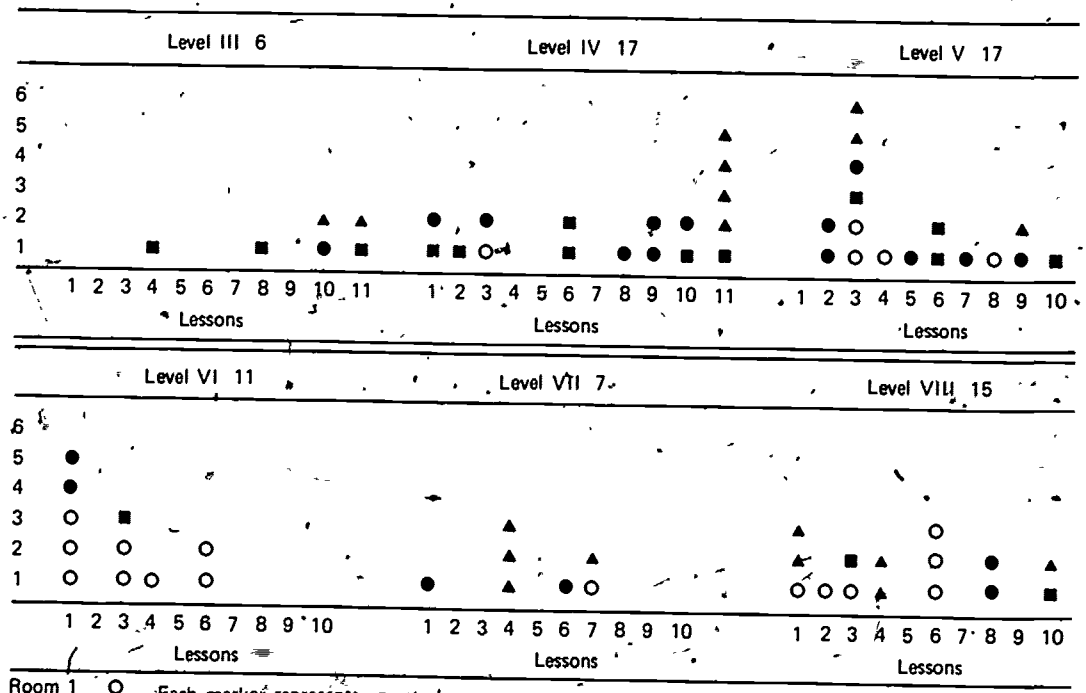
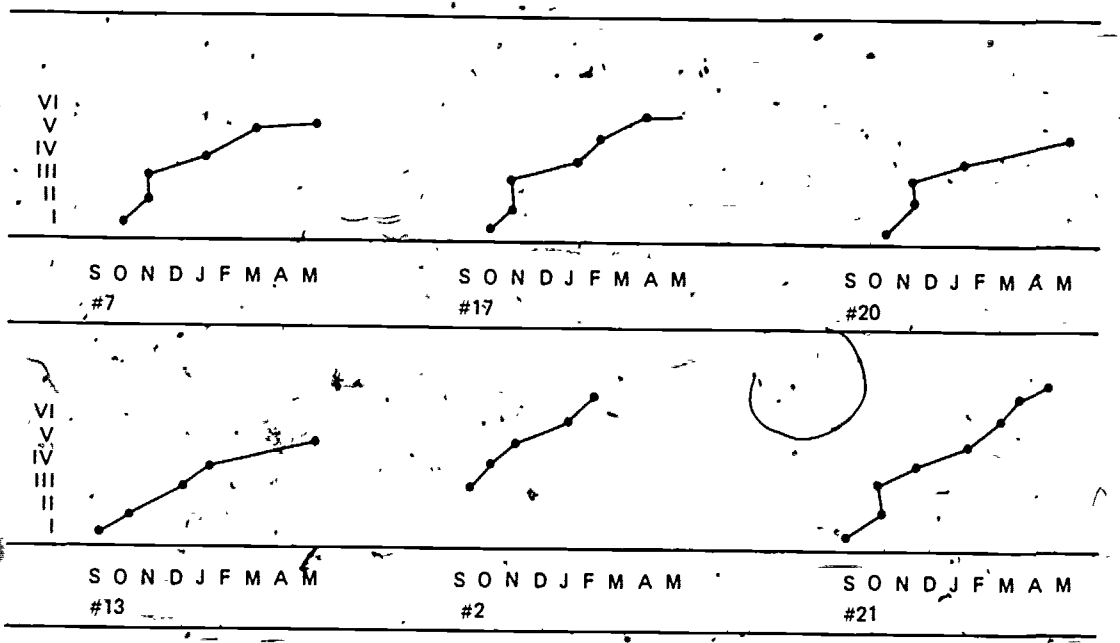


Figure 8. Distribution of students throughout *Levels and Lessons* of NRS at the end of Grade 1, June 1, 1974.



Selected students from classroom No. 1

Figure 9. Individual progress charts showing variations in rate of progression.

Conclusions

It is through the instructional strategy that learning theory enters the classroom. This study demonstrates and makes more explicit one designer's mode of introducing behavioral learning principles into the sequences of a structured curriculum. The analysis makes evident four main principles of instruction: (a) making explicit use of knowledge about the capabilities of the learner for whom the materials have been designed, (b) structuring language units so that they can be readily grasped by the learner, (c) identifying a progression of effective sequence types, and (d) specifying the contingencies of reinforcement.

The greatest contribution of this particular curriculum to knowledge of instruction in reading acquisition is the careful identification and sequencing of stimuli for learning to read, together with contingencies that focus attention on these stimuli. The greatest weakness of NRS lies in the lack of a complete "sensing" unit for evaluating student response in a continuous manner. The design task analysis, as elaborated in the materials, displays a good "match" with experimental task analyses described in the literature of research on reading acquisition. Still more precise measures need to be applied to the sequences of NRS to indicate the predictability of the strategies described.

Implications of the Study

Investigations related to curriculum in the past have been directed mainly toward understanding the effects of instruction. The focus has been on the effect of instructional conditions on achievement. This study, instead, looks at the instructional conditions themselves. The identification of behavioral elements in sequences allows for comparison with like elements in experimental research studies. This study differs from experimental research in that it deals with an entire curriculum extending over the course of an entire year. The study deals with the instructional treatment, the design, and production.

Although the particular curriculum analyzed here was a reading program, the method of analysis has general application to other types of curricula. The main point of the analysis is that it is concerned with the qualitative aspects of the instruction and depends upon rational analysis and description to accomplish its purpose. The method requires a clear identification of the variables and the establishment of meaningful relationships between them. The structure of the discipline being taught must be extracted from the materials and in some way compared with the structure as seen by researchers of, or in, that discipline. Tasks for learning should relate the content and the process of the skill in such a way that learning is facilitated. The results of such an analysis provide data useful in evaluating instructional products. The method then has general application to the assessment of instructional products, especially if these products have been developed according to principles that allow for the production of replicable sequences. As a technology of instruction develops and is applied to the design of educational materials, new methodologies for assessing these materials will be needed. The analysis performed in this study is an example of one such methodology.

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