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GRADUATE COLLEGE

THE UTILITY OF PHONIC GENERALIZATIONS TO SELECTED SCIENCE SERIES

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THE UTILITY OF PHONIC GENERALIZATIONS

TO SELECTED SCIENCE SERIES

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Dedicated to my granddaughter Kimberly Lyn

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THE UTILITY OF PHONIC GENERALIZATIONS TO SELECTED SCIENCE SERIES

CHAPTER I

THE STUDY

Introduction and Background

The first Harvard Report on reading examined the collegiate preparation of prospective teachers of reading. One of the most common deficiencies noted in student teachers was found to be a lack of understanding of phonetic principles.[1] Therefore, it was recommended: "that college instructors take greater responsibility in making certain that their students have mastered the principles of phonetic and structural analysis."[2]

The second Harvard Report, The First R, created more interest toward the teaching of phonics and structural analysis skills at the elementary school level. The authors of this study recommended "that continued emphasis be placed on helping children develop proficiency in word recognition through

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[1]Mary C. Austin and others, The Torch Lighters (Cambridge, Mass.: Harvard University Press, 1961), p. 82.

[2]Ibid., p. 146.

the use of meaning clues, visual analysis of word forms, sounding approaches, and the dictionary."[3]

Since that time, limited studies have reported findings that have analyzed the extent to which specific phonic and structural analysis generalizations are applicable in the materials used to teach students.

Word analysis skills are usually considered to be two different but related skills: phonics and structural analysis. According to Curry and Rigby "they are related because in many reading situations it becomes necessary to divide the word into its structural elements before the phonics principles can be applied."[4] "Independence in reading does not seem possible without phonetic and structural analysis skills. The ultimate goal is self-direction in the learning process."[5]

The question concerning phonics has been one of great debate. Smith stated that most teachers begin to teach phonics functionally as needed and this phonics teaching may continue even into high school.[6] Hildreth advises that "phonics is

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[3]Mary C. Austin and Coleman Morrison, The First R: The Harvard Report on Reading in Elementary Schools (New York: Macmillan Co., 1963), p. 221.

[4]Robert L. Curry and Toby W. Rigby, Reading Independence Through Word Analysis (New York: Charles E. Merrill Pub., 1969), p. 5.

[5]Emerald V. Dechant, Improving the Teaching of Reading (Englewood Cliffs, N.J.: Prentice-Hall, 1964), p. 194.

[6]Nila Banton Smith, "Phonics and Word Method: Origin and Development," Education Digest (Oct., 1958), 40.

essentially a system of generalizing about the sounds contained in different words, a process requiring the recognition of familiar elements in new settings."[7] A child's ability to recite phonic generalizations is no assurance that he has the ability to apply these generalizations in reading situations.[8] The generalization is something that must come from the learner as the result of experiences (guided, self-directed, and vicarious) he has had with words.[9] "Before the child can generalize about sounds in words, he needs to know a number of words which illustrate the generalization."[10]

Until the forties, the concept of teaching reading in the content fields had not been formulated. Since that time, there have been few comparative studies to relate the superiority of reading in a subject area to reading in a developmental program. The paucity of studies was particularly evident in the science content area. Studies which have been reported were more concerned with reading in the total school program.[11]

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[7]Gertrude Hildreth, "New Methods for Old in Teaching Phonics," Elementary School Journal, LVII, 436.

[8]Arthur W. Heilman, Phonics in Proper Perspective (Columbus, Ohio: Charles E. Merrill Books, Inc., 1964), p. 23.

[9]Emery P. Bliesmer, "Sequence of Reading Skills in Reading: Is There Really One?" Current Issues in Reading (Newark: International Reading Association, 1969), p. 125.

[10]Hildreth, op. cit., 436.

[11]Leonard Courtney, "Are We Really Improving Reading in the Content Fields?" Current Issues in Reading (Newark: International Reading Association, 1969), p. 18.

Rammal reported a study in which the Flesch readability formula was applied to analyze the reading level of science textbooks. The results of this study indicated that a great variation of readability existed between textbooks designed for the same field of science.[12]

Courtney reported a study by Cooper in which he found science-reading ability to be equally related to general vocabulary, English vocabulary, social studies vocabulary, and science vocabulary with correlation coefficients ranging from .66 to .85. Conclusions reached were that reading ability appears largely to be an expression of a student's total intellectual ability.[13]

Need for the Study

The studies which have examined the utility of the forty-five phonic generalizations taught in four basal reader programs, showed that fewer than one-half of the generalizations have a utility value high enough to recommend that they be taught. Additional studies need to be conducted investigating the utility of these generalizations, especially as applied to the vocabularies of the different content fields.

The renewed interest in science and the emphasis on reading to learn makes the reading of science even more important.

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[12]Joseph A. Rammel, "An Objective Study for the Bases of Selecting an Eighth Grade General Science Text Book," Science Education, XLVII, April, 1963, 259.

[13]Courtney, op. cit., p. 27.

Statement of the Problem

This study was to determine the utility of specific phonic generalizations to vocabularies in science textbooks. The sub-problems were: (1) What is the percentage of utility of each phonic generalization to the vocabulary taken from science textbooks in grades one through six? (2) Which of the forty-five phonic generalizations are required to identify words designated as science words? and (3) Are there differences in the utility of the generalizations to science series and reading series.

Basic Assumptions

The basic assumptions of the study were as follows:

1. That the forty-five phonic generalizations identified by Clymer in his study were representative of the phonic generalizations that may be required in reading the elementary science series.[14]

2. That the Clymer and Bailey studies of phonic generalizations utilized in selected reading programs offer a suitable basis for comparison of phonic generalizations applicable to elementary school science series.[15]

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[14]Theodore Clymer, "The Utility of Phonic Generalizations in the Primary Grades," Reading Teacher, XVI (January, 1963), 252-258.

[15]Ibid.; Mildred Hart Bailey, "The Utility of Phonic Generalizations in Grades One Through Six," The Reading Teacher, XX (February, 1967), 413-418.

3. That adequate "selection criteria" can be established for selecting representative science textbooks for analysis in the study.

Definition of Terms

The following operational definitions were relevant to this study:

Utility: Utility refers to the extent that use of phonic generalizations results in correct pronunciation of unrecognized words.

Phonic generalizations: Phonic generalizations refer to the application of phonetic elements, word structure, and syllabication principles to determine the sound associated with letters and combination of letters.

Science words: Science words are key concept words that have the same meaning to every other scientist.

Delimitations of the Study

The delimitations of the study were:

1. The study was limited to an analysis of three elementary science series.

2. The study was limited to the utilization of Clymer's forty-five phonic generalizations.[16]

3. The study was limited by the exclusion of abbreviations, contractions, foreign words, proper adjectives, and proper words.

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[16]Clymer, op. cit.

4. The study was limited to Webster's New Collegiate Dictionary, 1961 edition, as the authority for establishing pronunciation, accentuation, and syllabic-division for all words.[17]

Materials Used in the Study

Necessary to this investigation were the Clymer Study,[18] the Bailey Study,[19] Webster's New Collegiate Dictionary,[20] and the science textbooks, grades one through six, of the following series:

Paul F. Brandwein, and others. Concepts in Science. Chicago: Harcourt, Brace, and World Inc., 1966.

John G. Navarra, Joseph Zafforoni, and others. Today's Basic Science Series. Evanston, Ill.: Harper, Row, and Co., 1967.

H. Schneider and others. Heath Science Series. Boston: D. C. Heath and Co., 1965.

Review of Related Literature

There has been a revival of interest in the use of phonics in the reading program. Most educators agree that phonics generalizations should be taught, but they are unable to identify those generalizations which are of most value.

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[17] Webster's New Collegiate Dictionary (Springfield, Mass.: G. and C. Merriam Company, Publishers, 1961).

[18] Clymer, op. cit.

[19] Bailey, op. cit.

[20] Webster's New Collegiate Dictionary, op. cit.

Cordts investigated the vocabularies of forty-two primary readers. A total of 2,716 words were analyzed according to their phonetic elements. The words were classified as phonetic, phonic, or as being irregular. A phonetic word was one in which each letter represented a particular sound assigned to that letter. Of 1,600 one-syllable words, 224 phonetic words were found. The words were classified as being phonic by their vowel placement. There were 1,066 phonic words which were subdivided into three groups. Group one, words in which a single vowel had the sound assigned to it, contained 297 words. Group two, words in which there were combinations of vowels which had the sound assigned to them, contained 284 words. Group three, words to which no vowel letter to vowel sounds were made, contained 485 words. The final category of irregular words were those words which did not meet the criterion for classification as a phonetic or phonic word. There were 294 words in this classification. Of the 1,600 one-syllable words which were classified, there were only 805 words, or about one-half of the words, which could be taught according to phonic principles.[21]

In 1929 Horn used Cordts earlier study as a basis for the investigation of the different sound-letter association for the letter "a" alone. Horn found forty-seven different

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[21]Anna D. Cordts, "An Analysis and Classification of the Sounds of English Words in a Primary Reading Vocabulary," (unpublished Ph.D. dissertation, State University of Iowa, 1925.

sound-letter associations for the letter "a" in words occurring in First, Second, and Third grade readers.[22]

In 1952 Oaks summarized results from studies which reported on the use of the vowel in primary vocabularies. A great diversity of uses of vowels was found which indicated the need for an increased awareness, on the part of the teacher, of the wide range of sounds which primary children were expected to hear and associate with printed symbols.[23]

Ten years later, Burrows and Lourie tested the validity of the "two-vowel-together rule." A list of 1,728 words, which contained adjacent vowels, was taken from the Rinsland list. There were 668 words, of the 1,728 word list, which followed the two-vowel rule.[24]

In 1963 Clymer selected forty-five specific phonic generalizations, which were found in four basal reading series, and investigated their utility. A list was made of the words introduced in the four basic series from which the generalizations were drawn, plus the words from the Gates Reading Vocabulary for the Primary Grades. The present investigation

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[22]Earnest Horn, "The Child's Early Experience with the Letter 'a,'" Journal of Educational Psychology, XX (1929), 161-168.

[23]Ruth E. Oaks, "A Study of the Vowel Situation in a Primary Vocabulary," Education, LXXII, (May, 1952), 604-617.

[24]Alvina Treut Burrows and Zyra Lourie, "When 'Two Vowels Go Walking,'" The Reading Teacher, (November, 1963), 79-82.

utilized the following contributions from the Clymer study:[25]

1. The forty-five phonic generalizations which are recorded in Appendix A of this study.

2. The criteria for degree of utility of each generalization.[26]

Bailey replicated Clymer's study to determine the utility of the selected phonic generalizations as applied to words taken from basal readers for grades one through six. This study reported that there were only six generalizations applicable to large numbers of words which had few exceptions. Eight generalizations were found to possess a low percentage of utility and these eight should be reconsidered by persons concerned with reading instruction.[27]

In 1969 Davis[28] replicated Clymer's study to determine the applicability of phonic generalizations to selected spelling programs. Selection was made of six spelling series, levels two through six. A list of 5,000 spelling words was compiled, against which the phonic generalizations were tested for their applicability. This study reported twenty-six generalizations met the criteria of applicability.

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[25]Clymer, op. cit.

[26]Ibid.

[27]Bailey, op. cit.

[28]Lillie Smith Davis, "The Applicability of Phonic Generalizations to Selected Spelling Programs," (unpublished Ed.D. dissertation, University of Oklahoma, 1969.

Emans replicated Clymer's study to apply the forty-five phonic generalizations to a random sample of 10 per cent of the words (1,944 words) beyond the primary level (grade four in The Teacher's Word Book of 30,000 Words by Thorndike and Lorge).[29] The important findings revealed that some generalizations were more useful above the primary grades than in the primary grades. Emans reported thirteen generalizations which were found to be useful in both the primary and above the primary levels.[30]

Burmeister compared seven recent studies which scientifically investigated the value of many commonly found phonic, structural analysis, and accent generalizations. She concluded that certain generalizations, commonly taught, appear to have limited usefulness. For generalizations to be especially useful and clear it is important to differentiate between single and double vowels. When two vowels are together, they usually compose a phoneme.[31]

Summary

The revival of interest in the utility of phonic generalizations has been directed toward the basal reading program

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[29] E. L. Thorndike and I. Lorge, The Teacher's Word Book of 30,000 Words (New York: Teachers College, 1944).

[30] Robert Emans, "The Usefulness of Phonic Generalization Above the Primary Grades," The Reading Teacher, (February, 1967), 419-425.

[31] Lou E. Burmeister, "The Usefulness of Phonic Generalizations," The Reading Teacher, XXI, (January, 1968), 349-356.

in the elementary school. Because reading in the basal reader is only one phase of the total reading program, the skills developed here must be transferable to other areas, namely the content field.

The results of studies with vocabularies found in the basal reading series indicate a need for further investigations. The question posed is, What is the utility of these specific forty-five phonic generalizations when applied to the vocabulary found in science textbooks in grades one through six?

CHAPTER II

PROCEDURES

This research extended the Clymer[32] and Bailey[33] studies of the utility of forty-five phonic generalizations in reading programs to science programs. The list of generalizations and procedures developed by Clymer[34] were utilized in this study.

Selection of Generalizations

The generalizations, procedures, and criteria utilized in the study were those used by Clymer in his study of the utility of phonic generalizations in the primary reading program. The generalizations were selected from the teachers' manuals and consisted of five general types: (1) vowels, (2) consonants, (3) endings, (4) syllabication, and (5) miscellaneous relationships. The list of generalizations is recorded in Appendix A.

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[32]Clymer, op. cit.

[33]Bailey, op. cit.

[34]Clymer, op. cit.

Selection of Textbooks

The science series to be analyzed were selected from those listed in Textbooks in Print.[35] The selection was made on the basis:

1. The series encompassed grades one through six.

2. The series were published since 1965.

3. The series were frequently used. Judgment was made after consulting with Dr. John Renner, who identified those selected as books most frequently used.

The textbooks selected were:

Paul F. Brandwein, and others. Concepts in Science. Chicago: Harcourt, Brace, and World Inc., 1966.

John G. Navarra, Joseph Zafforoni, and others. Today's Basic Science Series. Evanston, Ill.: Harper, Row, and Co., 1967.

H. Schneider and others. Heath Science Series. Boston: D. C. Heath and Co., 1965.

Compilation of Vocabulary

The words were identified in three science textbook series, grades one through six. All words were recorded but the present study was limited by the exclusion of abbreviations, contracted forms, place names, proper names, proper adjectives, and words written with the apostrophe. Words connected by a hyphen were treated as compound words.

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[35] Textbooks in Print (New York: R. R. Bowker Company, 1966, 1967).

One exception to the delimitations was the inclusion of proper names in the list of key science concept words.

Each word was written on a card and then arranged alphabetically. On each card the following information was noted: the series, and whether it was considered to have a special scientific meaning. From this information a list of vocabulary words was organized.

Compilation of Science Words

The authors indicated, in each book, the words they considered to have special scientific meaning. This information was noted on the individual vocabulary cards. From this information, a separate science word list was compiled.

Recording of Word Pronunciations

An individual composite word list was made for each series. A separate list was compiled of words considered to have special scientific meanings. Webster's New Collegiate Dictionary,[36] 1961 edition, was chosen as the dictionary of authority for the study in order to analyze words from an orthographic rather than an auditory standpoint. The phonetic respelling, accentuation, and syllabic division of each word was recorded.

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[36] Webster's New Collegiate Dictionary, op. cit.

Determination of Utility of the Phonic Generalizations

The utility of each generalization was determined by testing the generalization against the respelling, accentuation, and syllabic division for each word. The applications and exceptions were noted. A per cent of utility was computed for each generalization by dividing the number of words pronounced as the generalization claimed by the total number of words to which the generalization could be expected to apply.

Criteria for Degree of Utility

Clymer set two criteria to constitute a reasonable degree of application. The two criteria were:

1. The word list must contain a minimum of twenty words to which the generalization might apply.

2. The second criterion was a per cent of utility of at least seventy-five. The per cent of utility was determined by dividing the total number of words pronounced as the generalization claimed by the total number of words to which the generalization could be expected to apply.

Summary

A group of approximately 12,000 words were taken from science textbooks and arranged in a list. Phonetic respelling for each word was recorded. The forty-five phonic generalizations were applied to the words and a per cent of utility

was computed for each generalization. These incidents were reported in appropriate tables in Chapter III.

CHAPTER III

FINDINGS

Utility of Generalizations to Science Textbooks

A list of approximately 12,000 words was compiled from three science textbook series, grades one through six. Webster's New Collegiate Dictionary[37] was used as the authority for the phonetic respelling, accentuation, and syllabic division of each word. The generalizations (Appendix A) were tested against the respelling, accentuation, and syllabic division for each word. The applications and exceptions for each generalization were noted. Two criteria were set to constitute a reasonable degree of application. The two criteria were:

1. That there should be an incident count of at least 20 to which the generalization might apply.

2. A seventy-five per cent utility should be attained.

The utility was determined by dividing the total number of words, pronounced as the generalization claimed, by the total number of words to which the generalization could be expected to apply. The data were recorded in Table 1.

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[37] Ibid.

An inspection of the date (Table 1) in accordance with the established criteria, indicated that twenty-eight generalizations (3, 4, 5, 8, 10, 11, 16, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 38, 40, 41, 44, 45) were found useful.

Of these generalizations which met the criteria, six generalizations (20, 21, 26, 27, 38, 29) were concerned with pronunciation where two consonants were together. Nine generalizations (30, 31, 32, 35, 36, 38, 40, 41, 45) were found to be useful for pronunciation by the use of syllabic division and accent placement.

Nine generalizations (20, 24, 25, 26, 27, 29, 35, 36, 41) had a utility of 100 per cent established. Three of this group of generalizations (26, 27, 35) had an incident count below 50. Five generalizations (20, 25, 29, 36, 41) had an incident count between 80 and 375. Generalization 23 had an incident count of 844.

Seven generalizations (1, 2, 5, 28, 30, 38, 39) had a high incident count of 1,000 or greater. Four generalizations (5, 28, 30, 38) met the two criteria established for this study. Generalization 30 had the highest number of incidents (4,076) with a utility level of 77 per cent.

A report of the findings for each generalization is presented in the following sections.

1. Generalization one, which was concerned with the principle of two adjacent vowels, had an incident count of

TABLE 1

SUMMARY OF UTILITY OF GENERALIZATIONS TO SCIENCE TEXTBOOKS[a]

*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
1. When there are two vowels side by side, the long sound of the first one is heard and the second is usually silent.	3149	1078(bean)	2071(air)	34
2. When a vowel is in the middle of a one-syllable word, the vowel is short.	1288	827	461	64
middle letter	344	260(big)	84(spark)	76
one of the middle two letters in a word of four letters	482	295(bend)	187(calf)	61
one vowel within a word of more than four letters	462	272(string)	190(minds)	61

[a]This table presents the composite findings for each of the forty-five recommended phonic generalizations. The number order of the generalizations in this table is identical with that in the tables shown in the Clymer and Bailey studies.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
*3.	If the only vowel is at the end of a word, the letter usually stands for a long sound.	27	22(so)	5(the)	81
*4.	When there are two vowels, one of which is final e, the first vowel is long and the e is silent.	444	337(coke)	107(sense)	76
*5.	The r gives the preceding vowel a sound that is neither long nor short.	3105	2769(charge)	336(sterilize)	89
6.	The first vowel is usually long and the second silent in the digraphs ai, ea, oa, and ui.	998	634	364	64
	ai	237	176(mail)	61(chair)	74
	ea	581	334(leak)	247(break)	57
	oa	120	107(coat)	13(broad)	89
	ui	60	17(suit)	43(rebuilt)	28

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
7.	In the phonogram ie, the i is silent and the e has a long sound.	230	47(brief)	183(tie)	20
*8.	Words having double e usually have the long e sound.	298	279(beet)	19(beer)	94
9.	When words end with silent e, the preceding a or i is long.	668	492(cake)	176(care)	74
*10.	In ay the y is silent and gives a its long sound.	104	100(day)	4(kayak)	96
*11.	When the letter i is followed by the letters gh, the i usually stands for its long sound and the gh is silent.	123	99(thigh)	24(eight)	81
12.	When a follows w in a word, it usually has the sound a as in was.	190	41(swam)	149(warm)	22
13.	When e is followed by w, the vowel sound is the same as represented by oo.	58	29(chew)	29(newer)	50

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
14.	The two letters ow make the long o sound.	226	138(sow)	88(plow)	61
15.	W is sometimes a vowel and follows the vowel digraph rule.	250	138(grower)	112(few)	55
*16.	When y is the final letter in a word, it usually has a vowel sound.	735	668(briefly)	67(pay)	91
17.	When y is used as a vowel in words, it sometimes has the sound of long i.	915	183(hybrid)	732(cloudy)	20
18.	The letter a has the same sound (o) when followed by l, w, and u.	649	205(talk)	444(algae)	32
*19.	When a is followed by r and final e, we expect to hear the sound heard in care.	22	20(hare)	2(are)	91
*20.	When c and h are next to each other, they make only one sound.	351	351(ditches)	0	100

*Generalizations marked with an asterisk were found "useful" acccrding to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
*21.	Ch is usually pronounced as it is in kitchen, catch, and chair, not like sh.	357	351(churches)	6(machine)	98
*22.	When c is followed by e or i, the sound of s is likely to be heard.	494	478(chance)	16(ocean)	97
*23.	When the letter c is followed by o or a, the sound of k is likely to be heard.	844	844(cone)	0	100
*24.	The letter g often has a sound similar to that of j in jump when it precedes the letter i or e.	353	307(ginger)	46(girder)	87
*25.	When ght is seen in a word, gh is silent.	120	120(insight)	0	100
*26.	When a word begins with kn, the k is silent.	27	27(know)	0	100
*27.	When a word begins with wr, the w is silent.	28	28(wrist)	0	100

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
*28.	When two of the same consonants are side by side only one is heard.	1571	1505(buffer)	66(suggested)	96
*29.	When a word ends in ck, it has the same last sound as in look.	84	84(flock)	0	100
*30.	In most two-syllable words, the first syllable is accented.	4076	3141(carbon)	935(depend)	77
*31.	If a, in, re, ex, de, or be is the first syllable in a word, it is usually unaccented.	1054	861(acetic)	193(area)	82
*32.	In most two-syllable words that end in a consonant followed by y, the first syllable is accented and the last is unaccented.	264	259(dimly)	5(supply)	98
33.	One vowel letter in an accented syllable has its short sound.	5661	3570(akin)	2091(basin)	63

*Generalizations marked with an asterisk were found "useful" acccrding to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
34.	When y or ey is seen in the last syllable that is not accented, the long sound of e is heard.	558	0	558(baby)	0
*35.	When ture is the final syllable in a word, it is unaccented.	38	38(culture)	0	100
*36.	When tion is the final syllable in a word it is unaccented.	245	245(detection)	0	100
37.	In many two- and three-syllable words, the final e lengthens the vowel in the last syllable.	733	454(before)	279(become)	62
*38.	If the first vowel sound in a word is followed by two consonants, the first syllable usually ends with the first of the two consonants.	2751	2085(cupful)	666(decrease)	76

*Generalizations marked with an asterisk were found "useful" acccrding to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
39.	If the first vowel sound in a word is followed by a single consonant, that consonant usually begins the second syllable.	2173	1143(adult)	1030(navigate)	53
*40.	If the last syllable of a word ends in le, the consonant preceding the le usually begins the last syllable.	212	158(crumble)	54(bottle)	75
*41.	When the first vowel element in a word is followed by th, ch, or sh, these symbols are not broken when the word is divided into syllables and may go with either the first or second syllable.	284	284(rushes)	0	100
42.	In a word of more than one syllable, the letter v usually goes with the preceding vowel to form a syllable.	406	249(deliver)	157(over)	61

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 1--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
43.	When a word has only one vowel letter, the vowel sound is likely to be short.	1331	915(hunt)	416(kind)	69
*44.	When there is one e in a word that ends in a consonant, the e usually has a short sound.	179	155(men)	24(blew)	87
*45.	When the last syllable is the sound r, it is unaccented.	783	766(brother)	17(transfer)	98

*Generalizations marked with an asterisk were found "useful" according to the criteria.

3,149. There were 1,078 incidents conforming to this generalization and 2,071 exceptions. A utility of 34 per cent was established. The number of incidents found for generalization one was a composite of incidents which included those found for generalizations six and eight. The overall utility of 34 per cent for generalization one was primarily supported by the special application of generalizations six and eight. When the incidents, which were identified by the special application of the digraph rules for generalization six, were removed from those incidents conforming with generalization one, the utility dropped from 34 per cent to 21 per cent. Further, the removal of those incidents applicable to generalization eight lowered the utility from 21 per cent to 9 per cent.

2. Generalization two, which was concerned with the placement of one vowel within a one-syllable word, had an incident count of 1,288. There were 827 incidents conforming to this generalization and 461 exceptions. A utility of 64 per cent was established.

(a) A subdivision of generalization two, which was concerned with vowel placement as the middle letter, had an incident count of 344. There were 260 incidents conforming to this generalization and 84 exceptions. A utility of 76 per cent was established.

(b) A subdivision of generalization two, which was concerned with a vowel letter as one of the middle two letters in a word of four letters, had an incident count of 482. There were 295 incidents conforming to this generalization and 187 exceptions. A utility of 61 per cent was established.

(c) A subdivision of generalization two, concerned with one vowel within a word of more than four letters, had an incident count of 462. There were 272 incidents conforming with this generalization and 190 exceptions. A utility of 61 per cent was established.

3. Generalization three, which was concerned with one vowel placed at the end of a word, had an incident count of 27. There were 22 incidents conforming with this generalization and 5 exceptions. A utility of 81 per cent was established.

4. Generalization four, which was concerned with two vowels one of which was a final e, had an incident count of 444. There were 337 incidents conforming with this generalization and 107 exceptions. A utility of 76 per cent was established.

5. Generalization five, which was concerned with a single vowel followed by the letter r, had an incident count of 3,105. There were 2,769 incidents conforming with this

generalization and 336 exceptions. A utility level of 89 per cent was established.

6. Generalization six, which was concerned with digraphs (ai, ea, oa, ui) had an incident count of 998. There were 634 incidents conforming with this generalization and 364 exceptions. A utility of 64 per cent was established.

(a) The subdivision ai of generalization six had an incident count of 237. There were 176 incidents conforming with this generalization and 61 exceptions. A utility of 74 per cent was established.

(b) The subdivision ea of generalization six had an incident count of 581. There were 334 incidents conforming with this generalization and 247 exceptions. A utility of 57 per cent was established.

(c) The subdivision oa of generalization six had an incident count of 120. There were 107 incidents conforming with this generalization and 13 exceptions. A utility level of 89 per cent was established.

(d) The subdivision ui of generalization six had an incident count of 60. There were 17 incidents conforming with this generalization and 43 exceptions. A utility of 28 per cent was established.

7. Generalization seven, which was concerned with the phonogram ie, had an incident count of 230. There were 47 incidents conforming with this generalization and 183 exceptions. A utility of 20 per cent was established.

8. Generalization eight, which was concerned with words having the double e, had an incident count of 298. There were 279 incidents which conformed with this generalization and 19 exceptions. A utility of 94 per cent was established.

9. Generalization nine, which was concerned with words which end with a silent e and how this affects the preceding a or i, had an incident count of 668. There were 492 incidents conforming to this generalization and 176 exceptions. A utility of 74 per cent was established. The incident count applicable to generalization nine was included in the incident count for generalization four, when the only vowel preceding the silent e was an a or an i. The incident count applicable to generalization nine was also included in the incident count for generalization thirty-seven, when the word was of two or more syllables and the vowel preceding the silent e was an a or an i.

10. Generalization ten, which was concerned with the ay combination, had an incident count of 104. There were 100 incidents conforming with this generalization and 4 exceptions. A utility of 96 per cent was established.

11. Generalization eleven, which was concerned with the letter i followed by gh, had an incident count of 123. There were 99 incidents conforming with this generalization and 24 exceptions. A utility of 81 per cent was established.

12. Generalization twelve, which was concerned with the letter w followed by the letter a, had an incident count of 190. There were 41 incidents conforming with this generalization and 149 exceptions. A utility of 22 per cent was established.

13. Generalization thirteen, which was concerned with the letter e followed by w, had an incident count of 58. There were 29 incidents conforming with this generalization and 29 exceptions. A utility of 50 per cent was established.

14. Generalization fourteen, which was concerned with the letter o followed by the letter w, had an incident count of 226. There were 138 incidents conforming with this generalization and 88 exceptions. A utility of 61 per cent was established.

15. Generalization fifteen, which was concerned with the letter w used as a digraph, had an incident count of 248. There were 136 incidents conforming with this generalization and 112 exceptions. A utility of 55 per cent was established.

16. Generalization sixteen, which was concerned with the letter y as the final letter in a word, had an incident count of 735. There were 668 incidents conforming with this generalization and 67 exceptions. A utility of 91 per cent was established. This utility was established even though exceptions were automatically established when the letters ay (generalization ten) were the final letters in a word.

Additional exceptions were established when generalization seventeen was applicable and the final y had the long i sound.

17. Generalization seventeen, which was concerned with the use of y as a vowel, had an incident count of 915. There were 183 incidents conforming with this generalization and 732 exceptions. A utility of 20 per cent was established.

18. Generalization eighteen, which was concerned with the letter a in combination with letters l, w, or u had an incident count of 649. There were 205 incidents conforming with this generalization and 444 exceptions. A utility of 32 per cent was established.

19. Generalization nineteen, which was concerned with the letter a followed by the letter r and final e, had an incident count of 22. There were 20 incidents conforming with this generalization and 2 exceptions. A utility level of 91 per cent was established. This generalization acted to make automatic exceptions when the incidents fall within generalizations four, nine, and thirty-seven.

20. Generalization twenty, which was concerned with pronunciation of the letters c and h when used together, had an incident count of 351. There were 351 incidents conforming with this generalization and zero exceptions. A utility level of 100 per cent was established.

21. Generalization twenty-one, which was concerned with the pronunciation of the letters ch, had an incident count of 357. There were 351 incidents conforming with this

generalization and 6 exceptions. A utility level of 98 per cent was established.

22. Generalization twenty-two, which was concerned with the letter c followed by the letter e or i, had an incident count of 494. There were 478 incidents conforming with this generalization and 16 exceptions. A utility level of 97 per cent was established.

23. Generalization twenty-three, which was concerned with the letter c followed by the letter o or a, had an incident count of 844. There were 844 incidents conforming with this generalization and zero exceptions. A utility level of 100 per cent was established.

24. Generalization twenty-four, which was concerned with the sound of the letter g when followed by the letter i or e, had an incident count of 353. There were 307 incidents conforming with this generalization and 46 exceptions. A utility level of 87 per cent was established.

25. Generalization twenty-five, which was concerned with the letters ght combined, had an incident count of 120. There were 120 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

26. Generalization twenty-six, which was concerned with words which begin with the letters kn, had an incident count of 27. There were 27 incidents conforming with this generalization and zero exceptions. A utility level of 100 per cent was established.

27. Generalization twenty-seven, which was concerned with words which begin with the letters wr, had an incident count of 28. There were 28 incidents conforming with this generalization and zero exceptions. A utility level of 100 per cent was established.

28. Generalization twenty-eight, which was concerned with the combination of two like consonants, had an incident count of 1,571. There were 1,505 incidents conforming with this generalization and 66 exceptions. A utility of 96 per cent was established.

29. Generalization twenty-nine, which was concerned with the consonants ck at the end of a word, had an incident count of 84. There were 84 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

30. Generalization thirty, which was concerned with the placement of the accent in two-syllable words, had an incident count of 4,076. There were 3,141 incidents conforming with this generalization and 935 exceptions. A utility of 77 per cent was established.

31. Generalization thirty-one, which was concerned with the accent of the first syllable when the letters a, in, re, ex, de, or be were the first syllable. There was an incident count of 1,054. There were 861 incidents conforming with this generalization and 193 exceptions. A utility of 82 per cent was established.

32. Generalization thirty-two, which was concerned with two-syllable words which end with a consonant followed by y, had an incident count of 264. There were 259 incidents conforming with this generalization with 5 exceptions. A utility of 98 per cent was established.

33. Generalization thirty-three, which was concerned with the sound of one vowel letter in an accented syllable, had an incident count of 5,661. There were 3,570 incidents conforming with this generalization with 2,091 exceptions. A utility of 63 per cent was established.

34. Generalization thirty-four, which was concerned with the letters y or ey in the last syllable, had an incident count of 558. There were zero incidents conforming with this generalization and 558 exceptions. A utility of zero per cent was established.

35. Generalization thirty-five, which was concerned with the letters ture in the final syllable, had an incident count of 38. There were 38 incidents conforming with this generalization with zero exceptions. A utility of 100 per cent was established.

36. Generalization thirty-six, which was concerned with the letters tion in the final syllable, had an incident count of 245. There were 245 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

37. Generalization thirty-seven, which was concerned with the final e in two- and three-syllable words, had an incident count of 733. There were 454 incidents conforming with this generalization and 279 exceptions. A utility of 62 per cent was established.

38. Generalization thirty-eight, which was concerned with two consonants following the first vowel in a word, had an incident count of 2,751. There were 2,085 incidents conforming with this generalization and 666 exceptions. A utility of 76 per cent was established.

39. Generalization thirty-nine, which was concerned with a single consonant following the first vowel sound, had an incident count of 2,173. There were 1,143 incidents conforming with this generalization and 1,030 exceptions. A utility of 53 per cent was established.

40. Generalization forty, which was concerned with the last syllable of a word ending with the letters le, had an incident count of 212. There were 158 incidents conforming with this generalization and 54 exceptions. A utility of 75 per cent was established.

41. Generalization forty-one, which was concerned with the consonants th, ch, or sh following the first vowel sound, had an incident count of 284. There were 284 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

42. Generalization forty-two, which was concerned with words of more than one syllable and the letter v going with the preceding vowel, had an incident count of 406. There were 249 incidents conforming with this generalization and 157 exceptions. A utility of 61 per cent was established.

43. Generalization forty-three, which was concerned with words which had only one vowel, had an incident count of 1,331. There were 915 incidents conforming with this generalization and 416 exceptions. A utility of 69 per cent was established. The specialized application of this generalization, which was contained in generalization forty-four, was concerned with the sound of the letter e within a word.

44. Generalization forty-four, which was concerned with words which contain one e and end with a consonant, had an incident count of 179. There were 155 incidents conforming with this generalization and 24 exceptions. A utility of 87 per cent was established.

45. Generalization forty-five, which was concerned with the last syllable when the sound is r, had an incident count of 783. There were 766 incidents conforming with this generalization and 17 exceptions. A utility of 98 per cent was established.

Summary

An analysis of the data indicated that twenty-eight generalizations (3, 4, 5, 8, 10, 11, 16, 19, 20, 21, 22, 23,

24, 25, 26, 27, 28, 29, 30, 31, 32, 35, 36, 38, 40, 41, 44, 45) were found useful according to the criteria.

Six of these generalizations (20, 21, 26, 27, 28, 29) were concerned with pronunciation where two consonants were together. Nine generalizations (30, 31, 32, 35, 36, 38, 40, 41, 45) were found to be useful for pronunciation by the use of syllabic division and accent placement.

Nine generalizations (20, 24, 25, 26, 27, 29, 35, 36, 41) had a utility of 100 per cent. Three of this group of generalizations (26, 27, 35) had an incident count below 50. Give generalizations (20, 25, 29, 36, 41) had an incident count between 80 and 375.

Seven generalizations (1, 2, 5, 28, 30, 38, 39) had a high incident count of 1,000 or greater. Four generalizations (5, 28, 30, 38) met the two criteria established for this study.

Generalization thirty-four, which was concerned with the long e sound of y or ey in the last syllable of an unaccented word, established an incident count of zero. It was concluded that this generalization was a regional pronunciation and the dictionary authority did not support this pronunciation; therefore, it was of no usefulness according to the criteria.

Generalizations Applied to Words Designated As Science Words

A list of 1,500 words, designated by the authors as science words, was compiled. The phonetic respelling, accentuation, and syllabic division of each word was recorded. The forty-five phonic generalizations (Appendix A) were applied to the words and a per cent of utility was computed for each generalization.

An inspection of the data (Table 2), in accordance with the established criteria, indicated that thirteen generalizations (3, 10, 11, 12, 13, 14, 19, 25, 26, 27, 29, 32, 35) did not meet the criterion of twenty words to which the generalization might apply. The subdivisions of generalization six (ai, oa, ui) also did not meet the criterion of twenty words to which the generalization might apply.

There were seventeen generalizations (4, 5, 8, 16, 20, 21, 22, 23, 24, 28, 30, 31, 36, 38, 40, 41, 45) which met both criteria of at least twenty words to which the generalization might apply and a utility of at least seventy-five per cent.

Seven generalizations (30, 31, 36, 38, 40, 41, 45) were found to be useful for pronunciation by the use of syllabic division and accent placement. Three generalizations (20, 21, 28) were concerned with pronunciation where two consonants were together.

TABLE 2

SUMMARY OF UTILITY OF GENERALIZATIONS TO SCIENCE WORDS[b]

*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
1. When there are two vowels side by side, the long sound of the first one is heard and the second is usually silent.	433	80	353	18
2. When a vowel is in the middle of a one-syllable word, the vowel is short.	179	109	70	61
middle letter	52	38	14	73
one of the middle two letters in a word of four letters	75	44	31	59
one vowel within a word of more than four letters	52	27	25	52

[b]This table presents the composite findings for each of the forty-five recommended phonic generalizations. The number order of the generalizations in this table is identical with that in the tables shown in the Clymer and Bailey studies.

TABLE 2--Continued

*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
3. If the only vowel letter is at the end of a word, the letter usually stands for a long sound.	0	0	0	0
*4. When there are two vowels, one of which is final e, the first vowel is long and the e is silent.	61	55	6	90
*5. The r gives the preceding vowel a sound that is neither long nor short.	438	377	61	86
6. The first vowel is usually long and the second silent in the digraphs ai, ea, oa, and ui.	85	47	38	55
ai	19	14	5	74
ea	51	25	26	49
oa	8	8	0	100
ui	7	0	7	0

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
7.	In the phonogram ie, the i is silent and the e has a long sound.	23	8	15	35
*8.	Words having double e usually have the long e sound.	32	30	2	94
9.	When words end with silent e, the preceding a or i is long.	105	72	33	69
10.	In ay the y is silent and gives a its long sound.	10	10	0	100
11.	When the letter i is followed by the letters gh, the i usually stands for its long sound and the gh is silent.	9	7	2	78
12.	When a follows w in a word, it usually has the sound a as in was.	19	1	18	5
13.	When e is followed by w, the vowel sound is the same as represented by oo.	4	3	1	75

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
14.	The two letters ow make the long o sound.	19	15	4	79
15.	W is sometimes a vowel and follows the vowel digraph rule.	23	16	7	70
*16.	When y is the final letter in a word, it usually has a vowel sound.	67	63	4	93
17.	When y is used as a vowel in words, it sometimes has the sound of long i.	141	50	91	35
18.	The letter a has the same sound (o) when followed by l, w, and u.	102	26	76	25
19.	When a is followed by r and final e, we expect to hear the sound heard in care.	2	2	0	100
*20.	When c and h are next to each other, they make only one sound.	52	52	0	100

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
*21.	Ch is usually pronounced as it is in kitchen, catch, and chair, not like sh.	52	49	3	94
*22.	When c is followed by e or i, the sound of s is likely to be heard.	77	73	4	95
*23.	When the letter c is followed by o or a, the sound of k is likely to be heard.	117	117	0	100
*24.	The letter g often has a sound similar to that of j in jump when it precedes the letter i or e.	63	61	4	94
25.	When ght is seen in a word, gh is silent.	8	8	0	100
26.	When a word begins with kn, the k is silent.	3	3	0	100
27.	When a word begins with wr, the w is silent.	4	4	0	100

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
*28.	When two of the same consonants are side by side only one is heard.	176	171	5	97
29.	When a word ends in ck, it has the same last sound as in look.	3	3	0	100
*30.	In most two-syllable words, the first syllable is accented.	458	398	60	87
*31.	If a, in, re, ex, de, or be is the first syllable in a word, it is usually unaccented.	88	67	21	76
32.	In most two-syllable words that end in a consonant followed by y, the first syllable is accented and the last is unaccented.	15	15	0	100
33.	One vowel letter in an accented syllable has its short sound.	824	515	309	63

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
34.	When y or ey is seen in the last syllable that is not accented, the long sound of e is heard.	35	0	35	0
35.	When ture is the final syllable in a word, it is unaccented.	5	5	0	100
*36.	When tion is the final syllable in a word it is unaccented.	47	47	0	100
37.	In many two- and three-syllable words, the final e lengthens the vowel in the last syllable.	139	83	56	60
*38.	If the first vowel sound in a word is followed by two consonants, the first syllable usually ends with the first of the two consonants.	348	268	80	77

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. or Words Conforming	Number of Exceptions	Per Cent of Utility
39.	If the first vowel sound in a word is followed by a single consonant, that consonant usually begins the second syllable.	400	224	176	56
*40.	If the last syllable of a word ends in le, the consonant preceding the le usually begins the last syllable.	29	22	7	76
*41.	When the first vowel element in a word is followed by th, ch, or sh, these symbols are not broken when the word is divided into syllables and may go with either the first or second syllable.	36	36	0	100
42.	In a word of more than one syllable, the letter v usually goes with the preceding vowel to form a syllable.	65	30	35	46

*Generalizations marked with an asterisk were found "useful" according to the criteria.

TABLE 2--Continued

	*Generalization	Total No. of Words	No. of Words Conforming	Number of Exceptions	Per Cent of Utility
43.	When a word has only one vowel letter, the vowel sound is likely to be short.	178	113	65	63
44.	When there is one e in a word that ends in a consonant, the e usually has a short sound.	29	21	8	72
*45.	When the last syllable is the sound r, it is unaccented.	108	105	3	97

*Generalizations marked with an asterisk were found "useful" according to the criteria.

Four generalizations (20, 23, 36, 41) had a utility of 100 per cent. Two of this group (36, 41) had an incident count below 50. Generalization twenty had an incident count of 52 and generalization 23 had an incident count of 117.

A report of the findings for each generalization is presented in the following sections.

1. Generalization one, which was concerned with the principle of two adjacent vowels, had an incident count of 433. There were 30 incidents conforming with this generalization and 352 exceptions. A utility of 18 per cent was established. The overall utility of 18 per cent for generalization one was primarily supported by the application of generalizations six and eight. When the incidents which were identified by the special application of the digraph rules for generalization six, were removed from those incidents conforming with generalization one, the utility dropped from 18 per cent to 9 per cent. Further, the removal of those incidents applicable to generalization eight lowered the utility from 9 per cent to one per cent.

2. Generalization two, which was concerned with the placement of one vowel within a one-syllable word, had an incident count of 179. There were 109 incidents conforming with this generalization and 70 exceptions. A utility of 61 per cent was established.

(a) A subdivision of generalization two, which was concerned with vowel placement as the middle

letter, had an incident count of 52. There were 38 incidents conforming with this generalization and 14 exceptions. A utility of 73 per cent was established.

(b) A subdivision of generalization two, which was concerned with a vowel letter as one of the middle two letters in a word of four letters, had an incident count of 75. There were 44 incidents conforming with this generalization and 31 exceptions. A utility of 59 per cent was established.

(c) A subdivision of generalization two, which was concerned with one vowel within a word of more than four letters, had an incident count of 52. There were 27 incidents conforming with this generalization and 25 exceptions. A utility of 52 per cent was established.

3. Generalization three, which was concerned with one vowel placed at the end of a word, had zero incidents with zero exceptions.

4. Generalization four, which was concerned with two vowels one of which was a final e, had an incident count of 61. There were 55 incidents conforming with this generalization and 6 exceptions. A utility of 90 per cent was established.

5. Generalization five, which was concerned with a single vowel followed by the letter r, had an incident count of 438. There were 377 incidents conforming with this

generalization and 61 exceptions. A utility of 86 per cent was established.

6. Generalization six, which was concerned with digraphs (ai, ea, oa, ui), had an incident count of 85. There were 47 incidents conforming with this generalization and 38 exceptions. A utility of 55 per cent was established.

(a) The subdivision ai of generalization six had an incident count of 19. There were 14 incidents conforming with this generalization and 5 exceptions. A utility of 74 per cent was established.

(b) The subdivision ea of generalization six had an incident count of 51. There were 25 incidents which conformed with this generalization and 26 exceptions. A utility of 49 per cent was established.

(c) The subdivision oa of generalization six had an incident count of 8. There were 8 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

(d) The subdivision ui of generalization six had an incident count of 7. There were zero incidents conforming with this generalization and 7 exceptions. A utility of zero was established.

7. Generalization seven, which was concerned with the phonogram ie, had an incident count of 23. There were 8 incidents conforming with this generalization and 15 exceptions. A utility of 35 per cent was established.

8. Generalization eight, which was concerned with words having the double e, had an incident count of 32. There were 30 incidents conforming with this generalization and 2 exceptions. A utility of 94 per cent was established.

9. Generalization nine, which was concerned with words which end with a silent e and how this affects the preceding a or i, had an incident count of 105. There were 72 incidents conforming with this generalization and 33 exceptions. A utility of 69 per cent was established.

10. Generalization ten, which was concerned with the ay combination, had an incident count of 10. There were 10 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

11. Generalization eleven, which was concerned with the letter i followed by gh, had an incident count of 9. There were 7 incidents conforming with this generalization and 2 exceptions. A utility of 78 per cent was established.

12. Generalization twelve, which was concerned with the letter w followed by the letter a, had an incident count of 19. There was 1 incident conforming with this generalization and 18 exceptions. A utility of 5 per cent was established.

13. Generalization thirteen, which was concerned with the letter e followed by w, had an incident count of 4. There were 3 incidents conforming with this generalization and 1 exception. A utility of 75 per cent was established.

14. Generalization fourteen, which was concerned with the letter o followed by the letter w, had an incident count of 19. There were 15 incidents conforming with this generalization and 4 exceptions. A utility of 79 per cent was established.

15. Generalization fifteen, which was concerned with the letter w used as a digraph, had an incident count of 23. There were 16 incidents conforming with this generalization and 7 exceptions. A utility of 70 per cent was established.

16. Generalization sixteen, which was concerned with the letter y as the final letter in a word, had an incident count of 67. There were 63 incidents conforming with this generalization and 4 exceptions. A utility of 93 per cent was established. This utility was established even though exceptions were automatically established when the letters ay (generalization ten) were the final letters in the word. Additional exceptions were established when generalization seventeen was applicable and the final y had the long i sound.

17. Generalization seventeen, which was concerned with the use of y as a vowel, had an incident count of 141. There were 50 incidents conforming with this generalization and 91 exceptions. A utility of 35 per cent was established.

18. Generalization eighteen, which was concerned with the letter a in combination with the letter l, w, or u, had an incident count of 102. There were 26 incidents conforming with this generalization and 76 exceptions. A utility of 25 per cent was established.

19. Generalization nineteen, which was concerned with the letter a followed by the letter r and final e, had an incident count of 2. There were 2 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

20. Generalization twenty, which was concerned with the pronunciation of the letters c and h when used together, had an incident count of 52. There were 52 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

21. Generalization twenty-one, which was concerned with the pronunciation of the letters ch, had an incident count of 52. There were 49 incidents conforming with this generalization and 3 exceptions. A utility of 94 per cent was established.

22. Generalization twenty-two, which was concerned with the letter c followed by the letter e or i, had an incident count of 77. There were 73 incidents conforming with this generalization and 4 exceptions. A utility of 95 per cent was established.

23. Generalization twenty-three, which was concerned with the letter c followed by the letter o or a, had an incident count of 117. There were 117 incidents conforming with this generalization with zero exceptions. A utility of 100 per cent was established.

24. Generalization twenty-four, which was concerned with the sound of g when followed by the letter i or e, had an incident count of 63. There were 61 incidents conforming with this generalization and 4 exceptions. A utility of 94 per cent was established.

25. Generalization twenty-five, which was concerned with the letters ght combination, had an incident count of 8. There were 8 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

26. Generalization twenty-six, which was concerned with words which begin with the letters kn, had an incident count of 3. There were 3 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

27. Generalization twenty-seven, which was concerned with words which begin with the letters wr, had an incident count of 4. There were 4 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

28. Generalization twenty-eight, which was concerned with the combination of two like consonants, had an incident count of 176. There were 171 incidents conforming with this generalization and 5 exceptions. A utility of 97 per cent was established.

29. Generalization twenty-nine, which was concerned with the consonants ck at the end of a word, had an incident count of 3. There were 3 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

30. Generalization thirty, which was concerned with the placement of the accent in two-syllable words, had an incident count of 458. There were 398 incidents conforming with this generalization and 60 exceptions. A utility of 87 per cent was established.

31. Generalization thirty-one, which was concerned with the accent of the first syllable when the letter a, in, re, ex, de, or be were the first syllable, had an incident count of 88. There were 67 incidents conforming with this generalization and 21 exceptions. A utility of 76 per cent was established.

32. Generalization thirty-two, which was concerned with two-syllable words that end with a consonant followed by y, had an incident count of 15. There were 15 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

33. Generalization thirty-three, which was concerned with the sound of one vowel letter in an accented syllable, had an incident count of 824. There were 515 incidents conforming with this generalization and 309 exceptions. A utility of 63 per cent was established.

34. Generalization thirty-four, which was concerned with the letters y or ey in the last syllable, had an incident count of 35. There were zero incidents conforming with this generalization and 35 exceptions. A utility of zero was established.

35. Generalization thirty-five, which was concerned with the letters ture in the final syllable, had an incident count of 5. There were 5 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

36. Generalization thirty-six, which was concerned with the letters tion in the final syllable, had an incident count of 47. There were 47 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

37. Generalization thirty-seven, which was concerned with the final e in two- and three-syllable words, had an incident count of 139. There were 83 incidents conforming with this generalization and 56 exceptions. A utility of 60 per cent was established.

38. Generalization thirty-eight, which was concerned with two consonants following the first vowel in a word, had an incident count of 348. There were 268 incidents conforming with this generalization and 80 exceptions. A utility of 77 per cent was established.

39. Generalization thirty-nine, which was concerned with a single consonant following the first vowel sound, had an incident count of 400. There were 224 incidents which conformed with this generalization and 176 exceptions. A utility of 56 per cent was established.

40. Generalization forty, which was concerned with the last syllable of a word ending with the letters le, had an incident count of 29. There were 22 incidents conforming with this generalization and 7 exceptions. A utility of 76 per cent was established.

41. Generalization forty-one, which was concerned with consonants th, ch, or sh following the first vowel sound, had an incident count of 36. There were 36 incidents conforming with this generalization and zero exceptions. A utility of 100 per cent was established.

42. Generalization forty-two, which was concerned with words of more than one syllable and the letter v going with the preceding vowel, had an incident count of 65. There were 30 incidents conforming with this generalization and 35 exceptions. A utility of 46 per cent was established.

43. Generalization forty-three, which was concerned with words which had only one vowel, had an incident count of 178. There were 113 incidents conforming with this generalization and 65 exceptions. A utility of 63 per cent was established.

44. Generalization forty-four, which was concerned with words that contain one vowel, an e, and end with a consonant, had an incident count of 29. There were 21 incidents conforming with this generalization and 8 exceptions. A utility of 72 per cent was established.

45. Generalization forty-five, which was concerned with the last syllable when the sound is r, had an incident count of 108. There were 105 incidents conforming with this generalization and 3 exceptions. A utility of 97 per cent was established.

Summary

A list of 1,500 words, designated to be science words, was compiled and phonetic respelling, accentuation, and syllabic division for each word was recorded. The forty-five generalizations (Appendix A) were applied to each word and the data revealed that there were thirteen generalizations which did not meet the twenty word criterion. There were seventeen generalizations which were found useful according to the criteria. Seven of these generalizations (30, 31, 36, 38, 40, 41, 45) were found to be useful for pronunciation by the use of syllabic division and accent placement. Five generalizations (20, 21, 22, 23, 28) were concerned with pronunciation where two consonants were together. The four generalizations (4, 5, 8, 16) were concerned with the silent e at the end of a word, two e's used together, the letter r

and the preceding vowel, and the y as a final letter. Three generalizations (22, 23, 24) were concerned with the letters c or g when followed by e, i, a, or o.

Comparison of Utility of Phonic Generalizations to Science and Reading Programs

This research extended the Clymer[38] and Bailey[39] studies of the utility of forty-five phonic generalizations (Appendix A) in reading programs to science programs. The list of generalizations and procedures developed by Clymer were utilized in the study.

The Clymer study was concerned with approximately two thousand six hundred words. The Bailey study was concerned with approximately five thousand seven hundred and seventy-three words. The science study was concerned with approximately twelve thousand words. The data from the Clymer, Bailey, and the science studies[40] were presented in Table 3. An analysis of this data indicated that eighteen generalizations (5, 8, 10, 16, 20, 21, 22, 23, 25, 28, 29, 30, 31, 32, 40, 41, 44, 45) were useful, according to the criteria established, and common to all three studies. Further analysis indicated twenty-four useful generalizations (3, 5, 8, 10, 16, 19, 20, 21, 22, 23, 24, 25, 28, 29, 30, 31, 32, 35, 36,

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[38] Clymer, op. cit.

[39] Bailey, op. cit.

[40] Throughout the remainder of this report, the science study refers to the problem pursued in this study.

TABLE 3

COMPARISON OF UTILITY OF PHONIC GENERALIZATIONS TO SCIENCE AND READING PROGRAMS[C]

Generalization	Utility		
	Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
1. When there are two vowels side by side, the long sound of the first one is heard and the second is usually silent.	45	34	34
2. When a vowel is in the middle of a one-syllable word, the vowel is short.	62	71	64
middle letter	(69)	(78)	(76)
one of the middle two letters in a word of four letters	(59)	(68)	(61)

[C]This table presents the composite findings for each of the forty-five recommended phonic generalizations. The number order of the generalizations in this table is identical with that in the tables shown in the Clymer and Bailey studies.

TABLE 3--Continued

Generalization	Utility: Per Cent of Utility: Primary Readers (Clymer)	Utility: Per Cent of Utility: Primary and Intermediate Readers (Bailey)	Utility: Per Cent of Utility: Elementary School Science Textbooks
one vowel within a word of more than four letters	(46)	(62)	(61)
3. If the only vowel letter is at the end of a word, the letter usually stands for a long sound.	74	*76	*81
4. When there are two vowels, one of which is final e, the first vowel is long and the e is silent.	63	57	*76
5. The r gives the preceding vowel a sound that is neither long nor short.	*78	*86	*89

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility		
	Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
6. The first vowel is usually long and the second silent in the digraphs ai, ea, oa, and ui.	66	60	64
ai	(64)	(72)	(74)
ea	(66)	(55)	(57)
oa	*(97)	*(95)	*(89)
ui	(6)	(10)	(28)
7. In the phonogram ie, the i is silent and the e has a long sound.	17	31	20

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility: Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
8. Words having double e usually have the long e sound.	*98	*87	*94
9. When words end with silent e, the preceding a or i is long.	60	50	74
10. In ay the y is silent and gives a its long sound.	*78	*88	*96
11. When the letter i is followed by the letters gh, the i usually stands for its long sound and the gh is silent.	71	71	*81
12. When a follows w in a word, it usually has the sound of a as in was.	32	22	22

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility: Per Cent of Utility: Primary Readers (Clymer)	Utility: Per Cent of Utility: Primary and Intermediate Readers (Bailey)	Utility: Per Cent of Utility: Elementary School Science Textbooks
13. When e is followed by w, the vowel sound is the same as represented by oo.	35	40	50
14. The two letters ow make the long o sound.	59	55	61
15. W is sometimes a vowel and follows the vowel digraph rule.	40	33	55
16. When y is the final letter in a word, it usually has a vowel sound.	*84	*89	*91
17. When y is used as a vowel in words, it sometimes has the sound of long i.	15	11	20

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility		
	Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
18. The letter a has the same sound (o) when followed by l, w, and u.	48	34	32
19. When a is followed by r and final e, we expect to hear the sound heard in care.	90	*96	*91
20. When c and h are next to each other, they make only one sound.	*100	*100	*100
21. Ch is usually pronounced as it is in kitchen, catch, and chair, not like sh.	*95	*87	*98
22. When c is followed by e or i, the sound s is likely to be heard.	*96	*92	*97
23. When the letter c is followed by o or a, the sound of k is likely to be heard.	*100	*100	*100

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility		
	Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
24. The letter g often has a sound similar to that of j in jump when it precedes the letters i or e.	64	*78	*87
25. When ght is seen in a word, gh is silent.	*100	*100	*100
26. When a word begins kn, the k is silent.	100	100	*100
27. When a word begins with wr, the w is silent.	100	100	*100
28. When two of the same consonants are side by side, only one is heard.	*99	*98	*96
29. When a word ends in ck, it has the same last sound as in look.	*100	*100	*100

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility: Per Cent of Utility: Primary Readers (Clymer)	Utility: Per Cent of Utility: Primary and Intermediate Readers (Bailey)	Utility: Per Cent of Utility: Elementary School Science Textbooks
30. In most two-syllable words, the first syllable is accented.	*85	*81	*77
31. If a, in, re, de, ex, or be is the first syllable in a word, it is usually unaccented.	*87	*84	*82
32. In most two-syllable words that end in a consonant followed by y, the first syllable is accented and the last is unaccented.	*96	*97	*98
33. One vowel letter in an accented syllable has its short sound.	61	65	63
34. When y or ey is seen in the last syllable that is not accented, the long sound of e is heard.	..	..	0
35. When ture is the final syllable in a word, it is unaccented.	100	*95	*100

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility: Per Cent of Utility: Primary Readers (Clymer)	Utility: Per Cent of Utility: Primary and Intermediate Readers (Bailey)	Utility: Per Cent of Utility: Elementary School Science Textbooks
36. When tion is the final syllable in a word, it is unaccented.	100	*100	*100
37. In many two- and three-syllable words, the final e lengthens the vowel in the last syllable.	46	46	62
38. If the first vowel sound in a word is followed by two consonants, the first syllable usually ends with the first of the two consonants.	72	*78	*76
39. If the first vowel sound in a word is followed by a single consonant, that consonant usually begins the second syllable.	44	50	53

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility		
	Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
40. If the last syllable of a word ends in le, the consonant preceding the le usually begins the last syllable.	*97	*93	*75
41. When the first vowel element in a word is followed by th, ch, or sh, these symbols are not broken when the word is divided into syllables and may go with either the first or second syllable.	*100	*100	*100
42. In a word of more than one syllable, the letter v usually goes with the preceding vowel to form a syllable.	73	65	61
43. When a word has only one vowel letter, the vowel sound is likely to be short.	57	69	69

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

TABLE 3--Continued

Generalization	Utility		
	Per Cent of Utility		
	Primary Readers (Clymer)	Primary and Intermediate Readers (Bailey)	Elementary School Science Textbooks
44. When there is one e in a word that ends in a consonant, the e usually has a short sound.	*76	*92	*87
45. When the last syllable is the sound r, it is unaccented.	*95	*79	*98

*Per Cent of Utility marked with an asterisk was found "useful" according to the criteria.

38, 40, 41, 44, 45) common to the Bailey and the science studies.

A report of the specific findings for each generalization is presented in the following section.

1. Generalization one, which was concerned with the principle of two adjacent vowels, established a utility of 45 per cent (Clymer), 34 per cent (Bailey), and 34 per cent (science study).

2. Generalization two, which was concerned with the placement of one vowel within a one-syllable word, established a utility of 62 per cent (Clymer), 71 per cent (Bailey) and 64 per cent (science study).

(a) A subdivision of generalization two, which was concerned with vowel placement as the middle letter, established a utility of 69 per cent (Clymer), 78 per cent (Bailey), and 76 per cent (science study).

(b) A subdivision of generalization two, which was concerned with a vowel letter as one of the middle two letters in a word of four letters, established a utility of 59 per cent (Clymer), 68 per cent (Bailey), and 61 per cent (science study).

(c) A subdivision of generalization two, which was concerned with one vowel within a word of more than four letters, established a utility of 46 per cent (Clymer), 62 per cent (Bailey), and 61 per cent (science study).

3. Generalization three, which was concerned with one vowel placed at the end of a word, established a utility of 74 per cent (Clymer), 76 per cent (Bailey), and 81 per cent (science study).

4. Generalization four, which was concerned with two vowels one of which was a final e, established a utility of 63 per cent (Clymer), 57 per cent (Bailey), and 76 per cent (science study).

5. Generalization five, which was concerned with a single vowel followed by the letter r, established a utility of 78 per cent (Clymer), 86 per cent (Bailey), and 89 per cent (science study).

6. Generalization six, which was concerned with digraphs (ai, ea, oa, ui), established a utility of 66 per cent (Clymer), 60 per cent (Bailey), and 64 per cent (science study).

(a) The subdivision ai of generalization six established a utility of 64 per cent (Clymer), 72 per cent (Bailey), and 74 per cent (science study).

(b) The subdivision ea of generalization six established a utility of 66 per cent (Clymer), 55 per cent (Bailey), and 57 per cent (science study).

(c) The subdivision oa of generalization six established a utility of 97 per cent (Clymer), 95 per cent (Bailey), and 89 per cent (science study).

(d) The subdivision ui of generalization six established a utility of 6 per cent (Clymer), 10 per cent (Bailey), and 28 per cent (science study).

7. Generalization seven, which was concerned with the phonogram ie, established a utility of 17 per cent (Clymer), 31 per cent (Bailey), and 20 per cent (science study).

8. Generalization eight, which was concerned with words having the double e, established a utility of 98 per cent (Clymer), 87 per cent (Bailey), and 94 per cent (science study).

9. Generalization nine, which was concerned with words which end with a silent e and how this affects the preceding a or i, established a utility of 60 per cent (Clymer), 50 per cent (Bailey), and 74 per cent (science study).

10. Generalization ten, which was concerned with the ay combination, established a utility of 78 per cent (Clymer), 88 per cent (Bailey), and 96 per cent (science study).

11. Generalization eleven, which was concerned with the letter i followed by gh, established a utility of 71 per cent (Clymer), 71 per cent (Bailey), and 81 per cent (science study).

12. Generalization twelve, which was concerned with the letter w followed by the letter a, established a utility of 32 per cent (Clymer), 22 per cent (Bailey), and 22 per cent (science study).

13. Generalization thirteen, which was concerned with the letter e followed by w, established a utility of 35 per cent (Clymer), 40 per cent (Bailey), and 50 per cent (science study).

14. Generalization fourteen, which was concerned with the letter o followed by the letter w, established a utility of 59 per cent (Clymer), 55 per cent (Bailey), and 61 per cent (science study).

15. Generalization fifteen, which was concerned with the letter w used as a digraph, established a utility of 40 per cent (Clymer), 33 per cent (Bailey), and 55 per cent (science study).

16. Generalization sixteen, which was concerned with the letter y as the final letter in a word, established a utility of 84 per cent (Clymer), 89 per cent (Bailey), and 91 per cent (science study).

17. Generalization seventeen, which was concerned with the use of y as a vowel, established a utility of 15 per cent (Clymer), 11 per cent (Bailey), and 20 per cent (science study).

18. Generalization eighteen, which was concerned with the letter a in combination with letters l, w, or u, established a utility of 48 per cent (Clymer), 34 per cent (Bailey), and 32 per cent (science study).

19. Generalization nineteen, which was concerned with the letter a followed by the letter r and final e, established

a utility of 90 per cent (Clymer), 96 per cent (Bailey), and 91 per cent (science study).

20. Generalization twenty, which was concerned with pronunciation of the letters c and h when used together, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

21. Generalization twenty-one, which was concerned with the pronunciation of the letters ch, established a utility of 95 per cent (Clymer), 87 per cent (Bailey), and 98 per cent (science study).

22. Generalization twenty-two, which was concerned with the letter c followed by the letter e or i, established a utility of 96 per cent (Clymer), 92 per cent (Bailey), and 97 per cent (science study).

23. Generalization twenty-three, which was concerned with the letter c followed by the letter o or a, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

24. Generalization twenty-four, which was concerned with sound of the letter g when followed by the letter i or e, established a utility of 64 per cent (Clymer), 78 per cent (Bailey), and 87 per cent (science study).

25. Generalization twenty-five, which was concerned with the letters ght combined, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

26. Generalization twenty-six, which was concerned with words which begin with the letters kn, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

27. Generalization twenty-seven, which was concerned with words which begin with the letters wr, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

28. Generalization twenty-eight, which was concerned with the combination of two like consonants, established a utility of 99 per cent (Clymer), 98 per cent (Bailey), and 96 per cent (science study).

29. Generalization twenty-nine, which was concerned with the consonants ck at the end of a word, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

30. Generalization thirty, which was concerned with the placement of the accent in two-syllable words, established a utility of 85 per cent (Clymer), 81 per cent (Bailey), and 77 per cent (science study).

31. Generalization thirty-one, which was concerned with the accent of the first syllable when the letters a, in, re, ex, de, or be were the first syllable, established a utility of 87 per cent (Clymer), 84 per cent (Bailey), and 82 per cent (science study).

32. Generalization thirty-two, which was concerned with two-syllable words which end with a consonant followed by y, established a utility of 96 per cent (Clymer), 97 per cent (Bailey), and 98 per cent (science study).

33. Generalization thirty-three, which was concerned with the sound of one vowel letter in an accented syllable, established a utility of 61 per cent (Clymer), 65 per cent (Bailey), and 63 per cent (science study).

34. Generalization thirty-four, which was concerned with the letters y or ey in the last syllable, established a utility of zero per cent in each of the Clymer, Bailey, and science studies.

35. Generalization thirty-five, which was concerned with the letters ture in the final syllable, established a utility of 100 per cent (Clymer), 95 per cent (Bailey), and 100 per cent (science study).

36. Generalization thirty-six, which was concerned with the letters tion in the final syllable, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

37. Generalization thirty-seven, which was concerned with the final e in two- and three-syllable words, established a utility of 46 per cent (Clymer), 46 per cent (Bailey), and 62 per cent (science study).

38. Generalization thirty-eight, which was concerned with two consonants following the first vowel in a word,

established a utility of 72 per cent (Clymer), 78 per cent (Bailey), and 76 per cent (science study).

39. Generalization thirty-nine, which was concerned with a single consonant following the first vowel sound, established a utility of 44 per cent (Clymer), 50 per cent (Bailey), and 53 per cent (science study).

40. Generalization forty, which was concerned with the last syllable of a word ending with the letters le, established a utility of 97 per cent (Clymer), 93 per cent (Bailey), and 75 per cent (science study).

41. Generalization forty-one, which was concerned with the consonants th, ch, or sh following the first vowel sound, established a utility of 100 per cent in each of the Clymer, Bailey, and science studies.

42. Generalization forty-two, which was concerned with words of more than one syllable and the letter v going with the preceding vowel, established a utility of 73 per cent (Clymer), 65 per cent (Bailey), and 61 per cent (science study).

43. Generalization forty-three, which was concerned with words which had only one vowel, established a utility of 57 per cent (Clymer), 69 per cent (Bailey), and 69 per cent (science study).

44. Generalization forty-four, which was concerned with words which contain one e and end with a consonant,

established a utility of 76 per cent (Clymer), 92 per cent (Bailey), and 87 per cent (science study).

45. Generalization forty-five, which was concerned with the last syllable when the sound is r, established a utility of 95 per cent (Clymer), 70 per cent (Bailey), and 98 per cent (science study).

Summary

This research extended the Clymer and Bailey research studies of the utility of forty-five phonic generalizations in reading programs to science programs. The list of generalizations (Appendix A) and procedures developed by Clymer were utilized in this study.

The data from the Clymer, Bailey, and the science studies were presented in Table 3. An analysis of these data indicated that eighteen generalizations (5, 8, 10, 16, 20, 21, 22, 23, 25, 28, 29, 30, 31, 32, 40, 41, 44, 45) were useful, according to the established criteria, and common to all three studies. Further analysis indicated twenty-four useful generalizations (3, 5, 8, 10, 16, 19, 20, 21, 22, 23, 24, 25, 28, 29, 30, 31, 32, 35, 36, 38, 40, 41, 44, 45) common to the Bailey and the science studies. There were four additional generalizations (4, 11, 26, 27) found useful only in the science study. Of the twenty-four generalizations that were considered useful in both the Bailey and science studies, there were eight generalizations (3, 19, 24,

26, 27, 35, 36, 38) which did not meet the criteria of usefulness in the Clymer study. It appeared that the low incident count in the Clymer study was the primary cause of the non utility of these generalizations.

Conclusions implied a positive relationship between the number of words in the study and the number of generalizations which were considered useful. The greater the number of words in each study the greater the number of generalizations which met the established criteria.

CHAPTER IV

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Studies of the utility of forty-five phonic generalizations to reading programs were extended to vocabularies in science textbooks and to words designated to have special science meaning. In addition, a comparison was conducted of the utility of the specific phonic generalizations to reading and science vocabularies.

A list of words was compiled from three science textbook series grades one through six. The generalizations and procedures developed by Clymer were utilized and controls were determined as listed in Chapter II. The utility of the generalizations was tested against the phonetic respelling, accentuation, and syllabic division of each word, according to Webster's New Collegiate Dictionary, 1961 edition. A per cent of utility was determined for each generalization by dividing the number of words or incidents investigated for the utility of the generalization.

An analysis of the data (Table 1) indicated twenty-eight generalizations were considered useful according to the established criteria. There were a total of 38,456 incidents

to which the forty-five generalizations were applied. Forty-nine per cent of this number of incidents were encompassed within the incidents concerning the twenty-eight useful generalizations. Ten generalizations, five of which were considered useful, were concerned with sixty per cent of the total number of incidents. The five useful generalizations (5, 28, 30, 31, 38) made up thirty-three per cent of the total incident count. Only generalization five was concerned with the use of vowels.

Within the twenty-eight generalizations considered useful in the science study, there were eleven generalizations which were concerned with vowels. Their incident count concerned one out of three incidents, of the total number of incidents, with which the twenty-eight useful generalizations were concerned, but only one out of six incidents of the total number of incidents. Six, of the twenty-eight generalizations, had a low incident count below one hundred, and twenty generalizations had an incident count below five hundred. The greatest consistency appeared within those incidents concerned with the sounds of consonants. Seventeen generalizations, of the nineteen consonant generalizations, met the criterion of usefulness. The remaining two generalizations established a utility greater than fifty per cent but less than seventy-five per cent.

The authors indicated, in each book, the words they considered to have special scientific meaning. The same

generalizations and procedures developed by Clymer were utilized for this list of words.

Thirteen generalizations did not meet the criterion of twenty words to which the generalization might apply. Seventeen generalizations were considered useful. Four generalizations, of this group of seventeen, were concerned with the use of vowels. Twelve generalizations established a utility of one hundred per cent, yet their incident count ranged from two to one hundred and seventeen incidents.

A comparison of the per cent of utility of specific generalizations to reading programs and science programs was made. The Clymer and Bailey studies were extended and the procedures and generalizations developed by Clymer were utilized in this study. There were eighteen generalizations common and useful to each study. There were twenty-four generalizations common and useful in the Bailey and science studies. Four generalizations were found useful in only the science study. The range of differences in percentage points of the utility of the forty-five generalizations was from zero to twenty-four points between the Bailey and the science studies. The differences in percentage points of the utility of the generalizations between the Clymer and the science studies ranged from one to twenty-two points. Eight generalizations, found useful in the Bailey and the science studies did not meet the criterion of incident count in the Clymer study. Three generalizations, concerned with silent

consonants, had a low incident count in each study and one hundred per cent utility.

Conclusions

On the basis of the findings of this investigation of the utility of the forty-five phonic generalizations, the following conclusions were reached:

1. The number of generalizations found to be useful in the reading studies and the science study suggested that reading word lists had been utilized as a word source; therefore, the indications were that skills taught in the reading program would also be useful in the content field.

2. Six generalizations (3, 9, 26, 27, 29, 35) had an incident count ranging between twenty-two and eighty-four. The teaching of these generalizations would be of questionable value in a phonics program.

3. Five generalizations (5, 28, 30, 31, 38) were concerned with high incident count ranging between one thousand and four thousand incidents. The high incident count and the high per cent of utility established indicated these generalizations to be of value.

4. Letters designated to be silent consonants indicated a stability of use; therefore, their inclusion in a phonics program should be considered.

5. The six generalizations, considered useful, concerned with pronunciation when two consonants were together

indicated a reliability that would make the knowledge of these generalizations valuable.

6. Indications were that the consonants c and g plus the vowels following them were consistently high in the sounds they represent and would be considered stable and of valuable use.

7. The wording of many of the generalizations, especially those pertaining to the sound of the letter y, were stated in a manner which made the acceptance of one generalization an automatic rejection of another. The reliability of the studies possibly would be improved if these generalizations were worded in a way to act independently from each other.

8. Since only forty-nine per cent of the total incidents fell within those generalizations which were considered useful, the indications were that only those generalizations with a high number of incidents plus a high per cent of utility should be included within a phonics program. Specifically generalizations 5, 28, 30, 31, and 38.

9. A consistency of usefulness was established by those generalizations concerned with the sound of consonants, syllabic division, and accent placement when twenty of the generalizations were considered useful in this study. Conclusions were that consistency of sounds were more reliable when they were concerned with consonants.

10. Conclusions were that there was an implied positive relationship between the number of words in a study and the number of generalizations which were considered useful.

11. Indications were that the utility of the generalizations remained equally constant for those words in the science study and those words designated to be science words.

12. Conclusions are that as the generalizations are presently worded only those generalizations concerned with large numbers of incidents, high per cent of utility, and concerned with the sound of consonants indicated enough utilitarian value and stability to be of value.

Recommendations

The conclusions reflected in this study indicated that there are many exceptions to the generalizations being taught to students.

This study did not answer the question as to which generalization should be taught. There may be other unstudied generalizations which possibly could be more helpful than those used in this study. Upon the basis that skills developed for reading may be utilized in the content fields, the following recommendations are made:

1. Future studies should be conducted to determine the optimum level of utility to be used as a criterion. The established level of seventy-five per cent utility may be

either too high or too low. The optimum level might be closer to fifty per cent.

2. Studies should be conducted to determine the most helpful generalizations to be taught. Because only forty-five generalizations were used for this study, a re-evaluation of generalizations might possibly indicate other generalizations of more value.

3. Research should be undertaken to determine if alternate generalizations should be taught when the first one fails. This method might enable the student to have a fifty per cent chance of being corrent.

4. Research should investigate the possibility that some generalizations may be applied in conjunction with other generalizations rather than in isolation. Specifically, generalizations such as number one and number thirty-six. The io combination in tion never has the double sound or long i sound.

5. Future studies should be concerned with the elimination of many of the generalizations whose usefulness is very doubtful. Specifically, generalizations 12, 17, 18, and 34 need to be restated, combined with other generalizations, or eliminated.

6. Studies should be conducted to determine if the wording of the generalizations correspond with the maturity level and understanding of children.

7. Investigations should be made to consider the possibility of other criteria for determining utility. An investigation could be made into the possibility of using the total number of words in which a generalization functions as the utility criterion rather than the total number of incidents.

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APPENDIX A

PHONIC GENERALIZATIONS

1. When there are two vowels side by side, the long sound of the first one is heard and the second is usually short.

2. When a vowel is in the middle of a one-syllable word, the vowel is short.

middle letter

one of the middle two letters
in a word of four letters

one vowel <u>within</u> a word of
more than four letters

3. If the only vowel letter is at the end of a word, the letter usually stands for a long sound.

4. When there are two vowels, one of which is final <u>e</u>, the first vowel is long and the <u>e</u> is silent.

5. The <u>r</u> gives the preceding vowel a sound that is neither long nor short.

6. The first vowel is usually long and the second silent in the digraphs <u>ai</u>, <u>ea</u>, <u>oa</u>, and <u>ui</u>.

ai

ea

oa

ui

7. In the phonogram ie, the i is silent and the e has a long sound.

8. Words having double e usually have the long e sound.

9. When words end with silent e, the preceding a or i is long.

10. In ay the y is silent and gives a its long sound.

11. When the letter i is followed by the letters gh, the i usually stands for its long sound and the gh is silent.

12. When a follows w in a word, the a usually has the sound of a as in was.

13. When e is followed by w, the vowel sound is the same as represented by oo.

14. The two letters ow make the long o sound.

15. W is sometimes a vowel and follows the vowel digraph rule.

16. When y is the final letter in a word, it usually has a vowel sound.

17. When y is used as a vowel in words, it sometimes has the sound of long i.

18. The letter a has the same sound (o) when followed by l, w, and u.

19. When a is followed by r and final e, we expect to hear the sound heard in care.

20. When c and h are next to each other, they make only one sound.

21. Ch is usually pronounced as it is in kitchen, catch, and chair, not like sh.

22. When c is followed by e or i, the sound of s is likely to be heard.

23. When the letter c is followed by o or a, the sound of k is likely to be heard.

24. The letter g often has a sound similar to that of j in jump when it precedes the letter i or e.

25. When ght is seen in a word, gh is silent.

26. When a word begins kn, the k is silent.

27. When a word begins with wr, the w is silent.

28. When two of the same consonants are side by side, only one is heard.

29. When a word ends in ck, it has the same last sound as in look.

30. In most two-syllable words, the first syllable is accented.

31. If a, in, re, ex, de, or be is the first syllable in a word, it is usually unaccented.

32. In most two-syllable words that end in a consonant followed by y, the first syllable is accented and the last is unaccented.

33. One vowel letter in an accented syllable has its short sound.

34. Whey y or ey is seen in the last syllable that is not accented, the long sound of e is heard.

35. When ture is the final syllable in a word, it is unaccented.

36. When tion is the final syllable in a word, it is unaccented.

37. In many two- and three-syllable words, the final e lengthens the vowel in the last syllable.

38. If the first vowel sound in a word is followed by two consonants, the first syllable usually ends with the first of the two consonants.

39. If the first vowel sound in a word is followed by a single consonant, that consonant usually begins the second syllable.

40. If the last syllable of a word ends in le, the consonant preceding the le usually begins the last syllable.

41. When the first vowel element in a word is followed by th, ch, or sh, these symbols are not broken when the word is divided into syllables and may go with either the first or second syllable.

42. In a word of more than one syllable, the letter v usually goes with the preceding vowel to form a syllable.

43. When a word has only one vowel letter, the vowel sound is likely to be short.

44. When there is one e in a word that ends in a consonant, the e usually has a short sound.

45. When the last syllable is the sound r, it is unaccented.

APPENDIX B

RUNNING WORD COUNT

*Series 1		*Series 2		*Series 3	
Grade 1	3,092	Grade 1	2,407	Grade 1	1,809
Grade 2	11,531	Grade 2	9,034	Grade 2	6,289
Grade 3	29,416	Grade 3	21,500	Grade 3	36,653
Grade 4	46,254	Grade 4	37,386	Grade 4	61,590
Grade 5	66,958	Grade 5	61,850	Grade 5	80,737
Grade 6	72,362	Grade 6	78,415	Grade 6	106,445

*Series 1 D. C. Heath

*Series 2 Harper Row and Co.

*Series 3 Harcourt, Brace and World

APPENDIX C

*a
abbreviation
abdomen
abdominal
abilities
*ability
ablaze
*able
*abroad
aborigines
*about
*above
aboveground
abruptly
absence
absolute
absolutely
*absorb
*absorbed
absorbent
absorbing
*absorbs
absorption
*abundance
*abundant
abundantly
accelerates
accelerator
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accessible
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accounts
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achieved
achieving
achievement
achievements
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acidic
*acids
acorn
*acorns
acquaintance
acquainted
acquire
acquired
acquires
acquiring
acre
acres
acrobats
*across
*act
acted

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*Words found in all three series.

acting
*action
actions
*active
actively
*activities
*activity
actors
*acts
*actual
*actually
*adapt
adaptation
adaptations
*adapted
adapts
*add
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addicted
addictions
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*addition
*additional
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*adds
adenosine
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adhesive
adjoining
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adjustments
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admits
admitted
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*adults
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advantages
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bookbinder
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brightness
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bruise
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bubbly
bucket
bucketful
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bud
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budge
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buffaloes
buffer
*bug
*bugs
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zooms

APPENDIX D

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alto
aluminum
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amnion
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ampere
amphibian
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amplitude
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bumblebee
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single-stage
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siphon
sips
Sirius

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skeletons
slaked
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Tahiti
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Tyrannosaurus
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Uranus
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vacant
vaccinated
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valleys
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vane
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variable
vein
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velocity
vena
ventricle
Venus
vermiculite
vertebra
vertebrae
vertebrate
vertebrates
vessels
vibrate
vibrating
vibration
villi
vinegar
violet
virus
viscous
vitamin
vitamins
vitreous
vocal
volcano
volt
volume

voluntary
wad
wall
warbler
warm
warm-blooded
warmest
water
watermelon
watershed
waterspout
watt
wave
wavelength
wavelengths
waves
wax
weather
weathering
weatherman
weaving
wedges
weevil
weigh
weight
well
whales
wheels
whistle
white
wind
window
winds
wires
wood
word
work
worms
wriggler
wrigglers
wrinkled
wrist
X-ray
yeast
yeasts
zero
zigzag
zoo