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ABSTRACT

Students at the secondary and postsecondary levels exhibit difficulty in the oral reading of scientific terminology, in part because of the abundance of polysyllabic words derived from Greek and Latin. Some of the problems observed include faulty stress placement, vowel insertion and deletion, vowel discrimination, and consonant insertion. Such practices as lexical reading through word classes, cloze techniques, and syntactic context are several techniques that teachers can utilize to improve students' oral reading of scientific terms. (RS)

LANGUAGE AND SCIENCE: IMPROVING ORAL READING

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ABSTRACT

Oral reading of science technology, especially those presented in a listing format, has been identified by science teachers as a problem for students enrolled in science classes. Using several contributions from linguistics, this paper presents several strategies to improve oral reading of science terminology of students at the secondary and post-secondary levels of instruction.

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Overview

It is difficult to read scientific literature without a knowledge of scientific terms or at least without a basis for understanding these terms. By understanding we mean not only the ability to determine the meaning of words but also the ability to master word perception skills. This latter skill takes into account such topics of word roots, prefixes, suffixes, spelling and word pronunciation or oral reading skills.

It does not mean that the difficulty experienced in science courses does not apply to other disciplines. However, in science, the range of linguistic possibilities is narrower than in other courses. For example, regarding negative prefixes, science seems limited, at least in terms of frequency, to the prefixes of a and dys to show negation. In other subjects, however, negation can take several forms. Among these are il, im, il, ir, un and so on. Furthermore, an analyst such as Wandersee (1985) has noted "Biology, with its binomial novenclature and its abundance of polysyllabic words derived from Greek and Latin, presents unique problems for the beginning student."

Problem

Informal dialogue with science teachers at the secondary and post-secondary levels of instruction and my experience as a teacher of general and content vocabulary indicate that students exhibit difficulty in reading scientific terminology. Some of the problems observed include such topics as vowel insertion (e.g., limnology and algology become liminology and algoology), consonant insertion (e.g., periodontis become periodontics), vowel deletion)e.g., physiology becomes

physology), faulty stress placement (e.g., microscopy and psychiatry become micróscopy and psychiátry) where the stress (indicated by raised digit ') is placed on the third instead of the second syllable.

It should be pointed out that oral reading is just one measure of assessing reading competence. Furthermore, oral reading is more demanding than silent reading in that it involves a motor skill. In many instances, oral reading takes its toll on the mature reader in that the act of reading aloud detracts from efficient reading. At any rate, the use of oral reading practice still has some value in ascertaining students' language ability.

This paper investigates the problem of oral reading with scientific terms and offers some suggestions for improving students' ability in this activity. The majority of the examples are taken from biological science since it is the science course most frequently encountered by secondary and post-secondary students as compared to such courses as chemistry, geology, and physics. First, a brief discussion of language theory is presented, followed by current classroom practice and then some suggestions for enhancing the teaching of scientific oral reading skills.

Language Theory

Language theory in this paper focusses on the principles underlying oral reading skills. In oral reading the individual is challenged to match the letters on the page (i.e., graphemes) with an acceptable mode of pronunciation (e.g., phonemes) on which most persons agree or which can be verified by consulting a dictionary. At the lowest level where there is a close correspondence between grapheme and

phoneme (e.g., mat, pin) oral reading is not difficult. On the contrary, where there is no such direct correspondence between grapheme and phoneme, reading is a more challenging task. Consequently, a different strategy should be utilized by the reader.

The reader, according to Chomsky (1973), does not look for grapheme-phoneme correspondences but rather for the correspondence of written symbols to the abstract level of words. In short, a mature reader reads at the lexical or deep level as opposed to the phonetic or surface level of analysis. For instance, the mature reader would observe the underlying regularity at the lexical level to generate such pronunciation between the words telegraph, telegraphic, and telegraphy where the stress marker ' is placed on the first, third, and second syllables, respectively.

As was mentioned above, language theory is concerned with issues such as the predictable nature of stress placement - a feature that is problematic for some students engaged in oral reading of scientific terms. Moreover, most of the scientific terms are of Latin and Greek derivation, and this process allows for a certain degree of predictability of stress placement with words of that origin. Thus, much of oral reading instruction should take into account the place of stress placement. Since much of the difficulty experienced by students relates to the latter phenomenon, we direct much of the discussion to this topic.

Literature Review

The topic of language and science has been addressed by several analysts. These topics include writing in the sciences (Ross and Jarosz, 1978; House, 1982; TePaske, 1982; Ryan, 1985) and improving

vocabulary and science concepts (Yager, 1983; Wandersee, 1985). Central to these investigations is the place of language in the teaching and learning of science. Yager, for instance, notes that part of the crisis in science education is the emphasis on words/terms and definitions as the primary ingredient of science. No one would argue that science does not have a specialized vocabulary. Biology, for example, has a specialized vocabulary derived primarily from Greek and Latin. An inability to master basic word structures (e.g., affixes and roots) poses problems for the beginning student.

Instructional Methods

Teaching oral reading of scientific terms with a prescribed list of words, for example, can take several forms. First, teachers may introduce the lists and pronounce the words as students listen to the teachers' model. Second, teachers may ask students to participate voluntarily in pronouncing the words. Another instructional practice is to work out a standardized pronunciation format on audiotape, for instance, with perhaps a phonetic transcription to aid pronunciation. As a matter of fact, most scientific texts at the introductory level include a glossary of terms with an accompanying phonetic transcription. In other instances, words in the body of the text have phonetic transcription in parentheses in proximity to the word (e.g., gemmules [jem-yoolz], coelenterates [suh-lent-uh-rayts], anemones [un-nem-uh-neez]). Each of the above instructional strategies has positive as well as negative features. For example, the voluntary method minimizes the necessity of having to call on students to respond when they may not be emotionally or cognitively prepared to do so. Thus, those who are

prepared to participate will usually do so. On the contrary, it is difficult to assess how much learning takes place on the part of those students who do not participate in the voluntary methodology of instruction.

Other Methods

In postulating other instructional practices to improve oral reading of science vocabulary, we can begin by focussing on these problem areas which frequently occur. These we observed were stress placement, vowel insertion and deletion and vowel discrimination (e.g., confusing long-short vowel distinction). Since stress placement is one of the most salient problems encountered by students in oral reading, we will focus on this facet of oral reading.

If the reader recalls, we said that stress placement of English words is a combination of underlying (lexical) and surface (phonetic) features of a word applying simultaneously. How many times have we not heard an individual making overt corrections of words when the word form changes (e.g., from noun to adjective sensitive to sensitivity or from verb to noun, distribute to distribution). This process also applies in reading scientific terms. Note, for example, how the rule of stress placement works in the following:

(1)	Algology	algological
(2)	Dermatology	dermatological
(3)	Limnology	limnological
(4)	Morphology	morphological
(5)	Pediatrics	pediatrician
(6)	Serology	serological

In the examples above, as with others, when the word group changes from one category to another (e.g., from practice to practitioner in Item 5 or from noun to adjective in Items 2 through 6), stress placement (as noted by raised digit ') is predictable in that the stress marker moves one syllable backwards from the words in the first column to those in the second column.

Thus, teachers can present pairs of scientific terms similar to those above and elicit responses in a quick response method. For example, one half of the class or one student could be responsible for the noun portion of the word, and the other would respond with the adjectival form. This practice could be alternated. In drills of this sort, the incorrect form is heard and can be jokingly embarassing for the respondent(s) when heard by other participants.

In addition to an instruction practice involving contrasts in word classes, teachers may seek to bring other related skills which are related to oral reading production. For example, the system of using the cloze technique in assessing students reading ability can also be included in this discussion. With a cloze technique, students are required to read a passage in which every fifth or seventh word is omitted. They are then required to supply the most appropriate word that would fill that slot. Competence in reading is assessed on how well students insert the most logical words for the omitted word.

With respect to oral reading in the sciences, teachers may present a passage which is reasonably familiar to students in that particular course and use the cloze procedure. In this task students engage in word analysis, logic, and grammatical structure to complete the missing

word. Obviously, teachers would want to choose a passage whose terms are familiar to all students in the class. In a modified cloze technique, teachers could place the words to be inserted in the passage at the top of the page and ask students to supply the most logical ones. This procedure would be similar to this format:

WORDS: biological, suprachiasmatic, hypothalamus circadian, metabolic, synthesis.

PASSAGE: The principal _____ clock appears to be located in the _____ nuclei of the _____, lesions of these _____ disrupt most _____ rhythm, and the _____ activity of neurons located there correlates with the day-night cycle. We do not know how _____ clocks keep time, although some investigators suggest that the rate of protein _____ times the individual "ticks."

Source: Carson, N. (1988). Physiological Psychology. Boston: Allyn and Bacon.

Teachers could also strive to improve oral reading skills at the syntactic level. This methodology allows students to employ sentences as the larger context in which they would insert the most appropriate scientific term from two choices. In this case, the most grammatically correct form would be the determinant of word mastery. This design would be as follows:

(1) Researchers found that _____ stimulation of
(electricity, electrical)
the brain stem produced arousal.

(2) The chart shows the _____ basis of
(physiology, physiological)
circadian rhythms.

(3) The primary biological clock of the rat is located in the
_____ nucleus of the hypothalamus.
(suprachiasm, suprachiasmatic)

Activities involving a cloze or a syntactic instructional strategy bring together related language skills to improve oral reading. For example, students would need to master the sense of the sentence to insert the correct word form. This mastery involves the concepts of subject, predication, coordination, subordination, and embedded structures-features of a sentence which readers and writers must master to obtain meaning from sentences. Thus, teaching techniques of this type bring together the totality of language skills which bear on oral reading. It is reasonable to assume that students will make several attempts to provide the correct responses. It is as if they are seeking "the best fit in arriving at correct forms." In the process, students will verbalize their responses to the cloze and to the sentence stimuli.

In another attempt to have students improve oral language competence with scientific terms, teachers can structure avenues for word use and reinforcement in class. For instance, teachers could have students simulate their defense of a proposal before a funding agency about a scientific project. This oral focus is important since much of secondary and post-secondary social settings work against the use of proper language. Lest they be perceived as acting out of the

norms of peer language use, students frequently use informal language whenever the opportunity arises. In the view of some students, it is difficult to use the language of their discipline with their peers. Consequently, this formally structured classroom activity would reduce an unwarranted fear of language use and would reinforce terms learned in the sciences.

In this paper, the aim was to advance some instructional methods to improve oral reading in the sciences. We noted that such practices as lexical reading through word classes, cloze techniques, and syntactic context are several techniques that teachers could utilize to improve oral reading of scientific terms.

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