Learning scientific and medical terminology with a mnemonic strategy using an illogical association technique

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Brahler CJ, Walker D. Learning scientific and medical terminology with a mnemonic strategy using an illogical association technique. Adv Physiol Educ 32: 219–224, 2008; doi:10.1152/advan.00083.2007.—For students pursuing careers in medical fields, knowledge of technical and medical terminology is prerequisite to being able to solve problems in their respective disciplines and professions. The Dean Vaughn Medical Terminology 350 Total Retention System, also known as Medical Terminology 350 (25), is a mnemonic instructional and learning strategy that combines mental imagery and keyword mnemonic elaboration processes to help students recall the scientific meaning of Greek and Latin word parts. High school students in Anatomy and Physiology classes at a career technology center were divided into experimental (Medical Terminology 350), control (rote memorization), or combination (Medical Terminology 350 and rote memorization) groups and completed pre- and posttests of standardized word recall tests. Students in the Dean Vaughn Medical Terminology 350 Total Retention System group achieved significantly greater pre- to posttest word recall improvement compared with students in both the rote memorization (P ≤ 0.0001) and combined rote memorization and Medical Terminology 350 (P ≤ 0.05) groups. There appeared to be a dose-dependent response as the pre- to posttest gain in word recall scores increased as exposure to the treatment increased.

In 2001, Anderson and Krathwohl revised Bloom’s original taxonomy (Fig. 1). They divided the knowledge dimension into factual knowledge, conceptual knowledge, procedural knowledge, and metacognition and created a matrix by adding a cognitive process dimension. The cognitive process dimension describes a hierarchy of processes used to learn such as remembering, understanding, applying, analyzing, evaluating, and creating.

The “factual” aspect of the knowledge dimension includes basic elements students must know to be acquainted with a discipline but that also will be required to solve complex problems in the discipline. The “remember” level of the cognitive process dimension includes such learning processes as retrieving relevant knowledge from long-term memory such as recalling the actions and side effects of a particular medication. The lower-order knowledge and thinking processes can provide critical components for more complex, higher-order problem-solving and critical-thinking activities (8).

For students pursuing careers in medical fields, knowledge of technical and medical terminology is prerequisite to being able to solve problems in their respective careers and disciplines (8). A pedagogy that has the potential to facilitate lower-order learning, such as memorization of medical terminology, may benefit educators and students by providing foundational knowledge that will be necessary for critical thinking and problem solving. An additional benefit of facilitating the memorization process is that valuable class time may be redirected toward activities that promote higher-order thinking (4).

The Dean Vaughn Medical Terminology 350 Total Retention System, also known as Medical Terminology 350 (25), is a learning system produced by DCM Instructional Systems to facilitate the recall of factual information by linking new material to an existing framework of life-long knowledge. Specifically, it creates an association to a Greek or Latin scientific word part by introducing a sound-alike keyword (audionym) and related visual image that is familiar to the learner but, however, unrelated to the medical term being learned. The visual image is then altered “illogically” to link the word part to its meaning. Medical Terminology 350 (25) postulates that the “crazier” or “more illogical” an association, the better it is to help recall, retain, and remember over a long period of time and in essence “learn” the meanings of word parts comprising medical terms.

Many cognitive psychologists, such as Reigeluth (18), agree that it is imperative that learners elaborate on new information to commit the new material to long-term memory. Elaboration occurs when the learner constructs a memory link between a bit of new information and some related information already held in long-term memory (12). Ideally, the learner pauses for a
moment and determines how to fit the new piece of information into the existing framework. The elaboration process is complete when the learner successfully fits the new information into their existing mental structures or schemata (22).

From a historical perspective, mnemonic strategies reach back to ancient Greece. Mnemonics have been used for centuries to acquire and retain new bits of information. Simonides of Ceos, a Greek lyric poet (circa 566-468 BCE), for instance, used the ancient “method of loci,” a mnemonic strategy for remembering and managing information. By placing mental images into imagined places in one’s mind like a theatrical backdrop, words and ideas were effectively remembered and recalled (17).

More recently, mnemonics has proven to be a useful tool to provide assistance to regular and special education students in the process of committing ideas and vocabulary to memory (16, 23). Mnemonics are thought to be effective because they transform nonmeaningful, nonsensical, “crazy” information into concrete, meaningful proxies (15).

The keyword method or strategy connects the new or unfamiliar information with what is already known by linking an acoustically similar keyword phrase to the “unfamiliar” information to be learned. This strategy can be demonstrated using the example of an acoustical cue such as the keyword “possum,” which sounds a lot like “posset.” “Posset” is defined as a hot drink of spiced milk curdled with wine. To recall this definition, the learner must employ the learning strategy by picturing a possum having a hot drink, which in turn triggers recall or retrieval of the answer (15). Another example of a scientific term might be the term “palisade,” which acoustically sounds like “palace.” “Palisade” means stake, so the learner pictures a palace with stakes all around the walls of the palace. This mental image cues the learner to recall that palisade means stake. This illogical association links the unfamiliar meaning to the familiar visual images and creates cognition (15).

Human thought is composed of autonomously created mental images. Our thoughts are framed in a structure of ordered and sequenced pictures constructing a scrapbook in our minds. Remembering is a process that retrieves that mental snapshot. Mental imagery is a mnemonic learning strategy that enables the student to expand upon new information by linking it to mental pictures of their past. Classical orators, cognitive psychologists, and philosophers suggest that mental organization structures itself in a spatial manner known as architectonics. Architectonics links mental functioning and architecture by imagining places or “loci” to form a network of order and structure in which to store information or retain knowledge (17). Creating pictures in our minds and labeling these images is our natural storage system. These labels or terms comprise the language of science. The process of learning science is active and complex (20) with understanding formed at the interface of terminology recall and conceptual constructs.

The purpose of this study was to test the effect of a mnemonic learning strategy that uses illogical word associations (the Dean Vaughn Medical Terminology 350 Total Retention System) on recall of Greek and Latin word parts constructing medical terminology compared with traditional memorization techniques for high school students at a career technology center in Dayton, OH.

**METHODS**

Written permission to conduct this study was provided by the principal of the career technology center, high school division, in a midwestern town in the United States (Dayton, OH). The Institutional
Table 1. Greek/Latin element pretest/posttest

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An element is defined as a Greek or Latin word part, either a prefix, root, suffix, or combining form of medical term.

Review Board at the University of Dayton approved the use of the data collected from the study under provision Code of Federal Regulations Title 45 Public Welfare, Department of Health and Human Services Part 46 Protection of Human Subjects [45 CFR 46.101(b) (4)]. Subjects were a convenience sample of senior Anatomy and Physiology students who were enrolled in vocational programs including but not limited to Medical Secretary and Dental Assisting programs.

The independent variable in this study was an audiovisual presentation that supplied an acoustical cue as a sound-alike name (audionym) and a cartoon-like picture for the learner to create a mental image coupling the keyword mnemonic and mental imagery elaboration processes for each medical term word part. An example of a term included in the study is the Greek word part “gastr-,” which means stomach. “Gastr-” sounds a lot like “gas truck,” which cues the learner to create the image of a gas truck in their “mind’s eye.” This image is then changed to a “gas truck with a stomach for a tank” (25). The learner connects the illogical image of a “gas truck with a stomach for a tank” by the acoustical cue or sound-alike name for the Greek element “gastr-.” This triangular mnemonic strategy is called the Dean Vaughn Medical Terminology 350 Total Retention System (Fig. 2).

In contrast to the Dean Vaughn Medical Terminology 350 Total Retention System strategy shown in Fig. 2, a linear pattern of rote memorization is shown in Fig. 3.

There were three different groups of students in this study, namely, an experimental or Dean Vaughn Medical Terminology 350 Total...
Retention System group \((n = 20)\), a control or rote memorization group \((n = 20)\), and a combination group who received both Dean Vaughn Medical Terminology 350 Total Retention System and rote memorization instruction \((n = 11)\). The experimental group included students from the Medical Secretary vocational program and students from mixed vocational areas. The combination group contained students from the Dental Assisting vocational program and mixed vocational areas. The control group contained students from mixed vocational areas. All instruction occurred on 4 consecutive days during regularly scheduled class sessions of 40-min periods. All students were provided with 3 \(\times\) 5-in. index cards, colored pencils, markers, a single-hole punch, and a looseleaf collator ring for creating their study materials.

Students in the Dean Vaughn Medical Terminology 350 Total Retention System group viewed an audiovisual learning module \((25)\) consisting of 25 medical elements or word parts each class period for 4 consecutive days. Students were instructed “not to take notes” while viewing the module presentation but to listen to the narrator for the pronunciation of the Greek/Latin word part, the audionym, and the meaning while creating a visual picture in their mind’s eye of the associated Medical Terminology 350 image. Following the presentation, students in the experimental group were instructed to create word bank cards that included the Greek or Latin element or word part, the sound-alike name cue, a sketch of the cartoon-like picture to form the mental image on the front of each index card, and the actual meaning of the term on the back of each index card. After completing the first 25 elements, students viewed the next module consisting of 25 more Greek and Latin elements of scientific terminology and created 25 additional word bank cards. This process was repeated until 100 elements had been presented and processed into 100 corresponding word bank cards.

Students in the control or rote memorization group were presented with the same 100 Greek or Latin elements, their meanings, and examples of actual scientific terms. They were not provided the acoustical clues or mental imagery supplied by the mnemonic strategy. Similar to the Dean Vaughn Medical Terminology 350 Total Retention System group, the students in the control group were given 25 elements each day for 4 consecutive days along with the meaning and examples of actual scientific terms and were instructed to make flash cards with the element or word part and to place the actual meaning of each term on the back of the card.

The “combination group” was composed of 11 students who experienced everything the control group did during the experimental period; however, they had viewed audiovisual modules from another Dean Vaughn Total Retention System, Dental Terminology, in a previous class. As such, these students had previous exposure to the Dean Vaughn Total Retention System strategy and medical terminology associated with the practice of dentistry.

All students completed the same word recall pretest (Table 1) the day before being presented with the first 25 terms and the same word recall posttest (Table 1) at the end of the 9-wk term. The dependent variable in this study was each student’s gain score, defined as the pretest to posttest change in recall of the meanings of Greek and Latin elements or word parts for the 100 scientific terms. ANOVA tests were completed to determine if there was a statistically significant difference in mean gain scores among the Dean Vaughn Medical Terminology 350 Total Retention System, control, or combination groups. Area of study/vocational program was identified as a potential confounder and was statistically controlled by determining if there was a statistically significant difference in gain scores between students in the medical secretary program, the dental assistant program, and mixed vocational programs. \(\alpha\) was set at 0.05 \((7)\).
RESULTS

The instructor observed that all of the students in the experimental group created word bank cards illustrating the Dean Vaughn Medical Terminology 350 Total Retention System process, and, although some students seemed skeptical of the process initially, all of the students in the treatment group enjoyed using this learning strategy because it made learning fun. Examples of two student word bank cards are shown in Fig. 4.

Mean gain scores were statistically significantly greater for the Dean Vaughn Medical Terminology 350 Total Retention System group compared with the control rote memorization ($P \leq 0.0001$) and combination groups ($P \leq 0.05$), as shown in Fig. 5. Mean gain scores were not statistically significantly different between students in the medical secretary program, the dental assistant program, and mixed vocational programs ($P \geq 0.05$).

DISCUSSION

These results support earlier research that using mnemonic strategies promotes effective recall of information such as vocabulary and terminology (16, 17, 20). Students in the Dean Vaughn Medical Terminology 350 Total Retention System group demonstrated significantly greater recall of meanings of Greek and Latin word parts using the triangular method of coupling keyword and mental imagery learning strategies compared with linear memorization in the control group and the combined linear memorization and mnemonic strategy group. Interestingly, the word recall gain scores for the students in the combination group, who had been exposed to part of the treatment as a component of their dental vocational program, were in between those of the control group and Dean Vaughn Medical Terminology 350 Total Retention System group.

Although not measured in this study, the investigators observed that students using the Dean Vaughn Medical Terminology 350 Total Retention System are not only able to retain the meanings of Greek and Latin word parts over a longer period of time compared with students who do not use the strategy but also demonstrate a greater understanding of scientific text. Knowing the meanings of Greek and Latin word parts at a glance allows for greater comprehension in a cumbersome technical, medical, and scientific reading. Recalling the word part “in context” increases the overall comprehension because the learner does not have to pause to look up the meaning of the word or skip over the “unknown term,” which in turn increases the understanding of the reader, enhancing their learning.

The Dean Vaughn Medical Terminology 350 Total Retention System appears to be equally effective in the postsecondary setting. The current investigators have found Medical Terminology 350 to be very effective for instructing Pharmacy Technicians, Phlebotomy Technicians, Medical Assistants, and Medical Secretary students at the Miami Valley Career Technology Center (Adult Education Division) in Clayton, OH. Additionally, Medical Terminology 350 was very effective for instructing adult English as a Second Language (ESL) students from the former Soviet Union as paramedical professionals speaking Russian and Lithuanian languages implemented Medical Terminology 350 to learn medical terms and English scientific vocabulary to enter the United States workforce.

The Dean Vaughn Medical Terminology 350 Total Retention System learning strategies appear to transfer to other learning situations as students reported they had successfully used the Dean Vaughn Total Retention System mnemonic strategy in other classes. They were reportedly able to recognize prefix, root, and suffix word parts and to know the meaning of complex vocabulary and terminology at a glance within the context of their reading. Students reported, “Although crazy, it works!” In fact, the crazier or less logical the association, the easier it was to recall, remember, and in essence “learn” the meanings of scientific terms without using a dictionary to look up each medical term by identifying the parts that comprise that word.

In summary, this study tested the effect of illogical word associations on the recall of Greek and Latin word roots comprising scientific terminology. The findings suggest that the “illogical association” illustrated by the Dean Vaughn Medical Terminology 350 Total Retention System process is an effective way to facilitate and improve the recall process because this tool effectively links the new material into an existing framework of knowledge and familiar associations.

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