
| RESEARCH ARTICLE

A Multiple-Associations Approach to Teaching Technical Terms in English for Specific Purposes Courses

Reima Al-Jarf

Full Professor of English and Translation Studies, Riyadh, Saudi Arabia

Corresponding Author: Reima Al-Jarf, E-mail: reima.aljarf@gmail.com

| ABSTRACT

Teaching and learning of technical terms constitute a major problem for ESP instructors and students. To help the students learn, retain, apply and relate technical terms, a multiple-associations instructional approach that focuses on connecting the printed form of the technical term with its pronunciation (the hidden sounds, double and silent letters, and homophones), with its part of speech, singular or plural form, synonym or antonym, English and Arabic meanings, usage, component parts (prefixes, suffixes, roots), previously-encountered terms and others should be followed while presenting the new technical terms in business, computer science and engineering to the students. Categorization, association, and visualization skills and mnemonic approaches should be emphasized. Mind maps can be used to show those connections. Out of class, extensive listening and reading activities are also encouraged. Quizzes should require the students to make the multiple associations described in the article. The multiple-associations instructional approach proved to be effective in enhancing the learning of technical terms by EFL college students. Further recommendations for strategies that can be used in teaching multiple associations are given.

| KEYWORDS

Associative learning, multiple associations, technical terms, specialized vocabulary, English for Specific Purposes, ESP.

| ARTICLE INFORMATION

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1. Introduction

Associative learning¹ states that ideas and experiences can be linked to one another and reinforce each other, and that we group and recall information together into one associative memory, as opposed to isolated events. Associative learning helps students connect with information more deeply and recall it with greater accuracy. In first and second language learning, the associative learning strategy is an essential mechanism for early language development and is an important means of acquiring vocabulary by pairing a concept with a word (Li, Jiang, Shang & Chen, 2021; Tsui, Byers-Heinlein & Fennell, 2019).

A review of the language learning literature showed that associative learning has been the subject of research by numerous studies, especially in vocabulary learning. For example, Li, Jiang, Shang and Chen (2021) constructed a dynamic vocabulary network model based on the distributed association strategy. They found that the model can effectively reflect the associative learning process of vocabulary acquisition. Results also revealed the dynamic and evolutionary laws governing vocabulary networks when using the associative learning strategy.

In two other studies, Pressley and Others (1982) and Pressley and Others (1981) compared the keyword method of vocabulary instruction (the to-be-learned item) with five ways for increasing the semantic processing of vocabulary definitions. The keyword method enhanced vocabulary/definition (associative) learning. On the contrary, the semantic conditions tended to increase non-

¹ <https://study.com/academy/lesson/associative-learning-definition-theory-examples.html#:~:text=Associative%20learning%20is%20a%20principle,used%20in%20classroom%20management%20techniques>.

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associative learning of vocabulary definitions. The authors concluded that the keyword method is superior to semantic-based strategies as a vocabulary-learning procedure.

The associative method in presenting new English words to Chinese EFL students made significant short- and long-term retention of English words. It was more efficient in retaining monosyllabic, disyllabic, and polysyllabic words (Zhang, 2014).

In addition, comparisons of the role of unisensory and multisensory tasks in associative vocabulary learning in developing unisensory and multisensory processes in children and adults were made. A simple audio-visual detection task and three incidental associative learning tasks with different sensory signals were applied: Visual-verbal with pseudowords, novel audiovisual, and visual-visual. Associative learning was significantly enhanced by verbal sounds, compared to new audio-visual and unisensory visual learning. Visual-verbal learning was also the best predictor of children's general intellectual abilities (Barutchu, Fifer, Shivdasani, Crewther and Paolini, 2020).

The relationship between vocabulary learning strategies and vocabulary knowledge breadth and depth in first-year university students in China was investigated by Zhang and Lu (2015). The students took two tests: The Vocabulary Levels Test, which is a meaning recall task, was administered to elicit meaning recognition (passive recognition) and meaning recall (passive recall). The second test was the Depth of Vocabulary Knowledge Test for eliciting the students' vocabulary knowledge depth. Strategies that focus on learning the forms and associative meanings of words were significant predictors of both vocabulary knowledge breadth and depth. However, learning strategies of the same type might have different effects on meaning recognition and meaning recall.

To find out the effect of learning direction in retrieval practice on EFL vocabulary learning, EFL Japanese students studied new English words in two directions (L1 to L2 and L2 to L1), where L1 stands for the first language and L2 stand for the second language. The results showed that L2 proficiency influences the effects of learning direction on vocabulary learning. For lower-proficiency learners, L2-to-L1 learning was more effective than L1-to-L2 learning, whereas L1-to-L2 learning was more effective for higher-proficiency learners (Terai, Yamashita and Pasich, 2021).

Hoshino (2010) examined whether synonyms, antonyms, categorical, thematic, and arbitrary word lists facilitated L2 vocabulary learning by Japanese students in the classroom. The students were placed into four groups according to their learning styles, and the study compared the relative effectiveness of the types of word lists on different types of learning styles. The most effective type of word list did not vary according to students' learning style. All the students memorized the words in the categorical list more effectively than those in the non-categorical lists. Hence, the type of word list had a stronger effect on the efficacy of vocabulary learning than the individual learning style did.

A second group of studies in the literature focused on word knowledge dimensions in second language (L2) vocabulary. L2 college learners completed a series of word knowledge tests comprised of tasks that measure vocabulary size, word associates, morpheme-form knowledge, morpheme-meaning knowledge, morpheme discrimination, and morpheme recognition, real-word inference and pseudoword inferencing. It was found that word-knowledge dimensions made a collective contribution to L2 lexical inference. Word associates and morpheme-form knowledge had the strongest predicting power among all word-knowledge components (Zhang & Pei, 2022).

Martin and Ellis (2012) analyzed the relationship between the phonological short-term memory and working memory and vocabulary and grammar learning in an artificial foreign language. Nonword repetition, nonword recognition, and listening span were used as memory measures. The students learned the singular forms of words in an artificial foreign language before being exposed to the plural forms in sentence contexts. Then they were tested on their ability to induce the grammatical forms and to generalize the forms to novel utterances. The results demonstrated significant independent effects of phonological short-term memory and working memory on L2 vocabulary and L2 grammar learning.

At a Dutch secondary school, the phonological specificity training resulted in increased learning, whereas picture selection produced increased learning only for students with larger initial vocabulary sizes. Phonological specificity training showed more learning immediately after the intervention for words with nonnative contrasts than picture selection. The results suggested that phonological features can augment meaning-focused L2 vocabulary learning interventions (van de Ven, Segers & Verhoeven, 2019). Likewise, English-as-a-foreign-language (EFL) Chinese six-grade students with poorer L1 phonological awareness were less capable of extracting phonological patterns from L2 and thus had difficulties capitalizing on this knowledge to support L2 vocabulary learning (Hu, 2014).

Another dimension of word knowledge is morphological analysis. Azad and Ahmadian (2021) found that morphological analysis had a more significant effect on vocabulary retention than incidental learning by upper-intermediate EFL Iranian students. The

researchers recommended that morphological analysis be employed as a valuable source for TOEFL vocabulary learning and teaching by both teachers and learners, and as a strategy for vocabulary teaching in ESP or EAP courses.

Similarly, results of three tests and the Gardner's' (1983) Multiple Intelligences questionnaire showed significant differences in the accessibility of phonological, semantic, and orthographic aspects of words in L2 vocabulary learning by intermediate EFL Iranian students. No significant relationships were found between spatial and linguistic intelligences and the phonological, orthographic, and semantic aspects of lexical knowledge (Zarei & Aleali, 2015).

In Japan, EFL students studied 24 English homographs (a) while making pleasantness ratings about word meaning (mapping plus semantic processing); (b) while counting letters in each word (mapping plus structural processing); and (c) without any additional task (mapping only). Results of L1 and L2 free recalls and L2-to-L1 and L1-to-L2 cued recalls indicated higher free recall in the semantic condition than the structural condition and a higher cued recall in the mapping condition than the semantic and structural conditions (Kida & Barcroft, 2018).

In Saudi Arabia, Masrai and Milton (2015) investigated EFL Arab learners' word difficulty in relation to repetition of words in the learners' EFL textbooks, word length, parts of speech, and word translation to the students' first language (Arabic). Results of a vocabulary test that required the students to identify whether a word was known to them and then to supply its Arabic meaning showed a large effect of repetition on L2 vocabulary learning, followed by translation equivalents. Word length and the parts of speech were non-significant to the students' overall learning.

In English for Specific Purposes (ESP) and English for Academic Purposes (EAP) courses, teaching and learning of technical vocabulary constitute a major problem for both instructors and students as such courses are heavily loaded with Greek and Latin roots. Moreover, students have difficulty in pronouncing, spelling, recognizing the meaning of and using English words (Azad & Ahmadian, 2021; Zhang, 2014; Al-Jarf, 2022f; Al-Jarf, 2021b; Al-Jarf, 2006; Al-Jarf, 1994).

Furthermore, there is lack of studies that investigate associative learning of technical terms in ESP, particularly English for Business, Engineering and Computer Purposes. To help students enrolled in those courses learn, retain, apply, and relate technical terms, this study proposes an instructional approach that is based on the associative learning theory. This approach focuses on making multiple associations that focus on the phonological, orthographic, morphological, and semantic aspects of technical terminology while teaching and learning the new technical terms in business, computer science and engineering. It shows instructors what kinds of associations to make while teaching specialized terminology in ESP.

The multiple-associations approach to teaching the technical term knowledge dimensions reported by studies above will widen students' knowledge of technical terms, and help them learn technical terms more deeply as studying the phonological, orthographic, morphological and semantic dimensions is enriching and will help them in understanding future lectures and reading and comprehending specialized material easily.

2. Types of Associations That Can Be Made In Teaching Technical Terms

Students learning English for Business, Engineering and Computer Science Purposes study single specialized technical terms, specialized compound terms, specialized collocations and idioms, foreign (non-English) terms used in the field (*per capita*, *entrepreneur*, *data*, *strata*), abbreviations and acronyms (*LTD*, *GNP*, *GDP*, *CEO*, *RMB*, *co. SNB*), symbols ($\$$; m ; ϕ ; β ; ρ ; σ ; φ ; Ψ), formulas ($PEoD = (\% \text{ Change in Quantity Demanded})/(\% \text{ Change in Price}) = \text{Price Elasticity of Demand}$) and others. For effective teaching of technical terms in English for Business, Computer Science and Engineering, instructors can make the following phonological, orthographic, morphological and semantic associations pertaining to the terms under study:

- 1) Connect the printed form of the technical term, compound, acronyms, abbreviations, symbols or formula with its pronunciation (Al-Jarf, 2022d; Al-Jarf, 2019a; Al-Jarf, 2008b). For each technical term, show the students the following:
 - Hidden sounds as in the following examples:
 - /ʃ/ sound: *insurance*, *quotient*, *coefficient*, *social*, *facial*.
 - /ʃ/ sound: *potential*, *artificial*, *partial*, *Inertia*.
 - /tʃ/ sound: *structure*, *saturation*, *temperature*, *opportunity*, *mutual*.
 - Ch pronounced as /k/: *chemical*, *mechanical*, *machine*, *mechanism*.
 - Different pronunciations of -tion: *combustion*, *digestion*, *consumption*, *negotiation*.
 - Different pronunciations of -sion: *tension*, *vision*, *corrosion*, *compression*, *pressure*.
 - Pronunciation of sc, cc: *scientist*, *accelerate*, *access*, *account*
 - Double u: *continuum*, *vacuum*.

- Double consonants: *attend, appendix, associate, association, assess, access.*
 - Silent letters: *pneumatics, design, toughness, enough, strength, through, although.*
 - Words with the same vowel digraphs but different pronunciation: *heart, heard, clean, clear.*
 - Words with different vowel digraphs but the same pronunciation: *receive, lead, speed.*
 - Homophones: *site, cite, sight.*
 - Homographs: *read & read; bass & bass.*
 - Words with 2 stress forms according to their part of speech: *separ'ate (V), 'Separate (Adj); 'complement (N), comple'ment (V), 'present (N, pre'sent (V).*
 - Compounds: *electro/dynamics, electro/mechanics, net/work.*
 - Pronunciation of foreign terms: *entrepreneurship, entrepreneur.*
- 2) Connect terms with spelling/pronunciation changes that take place when suffixes are added:
- *Consume, consumption*
 - *Coordinate, coordination*
 - *Adapt, adaptable, adaptability*
 - *Part, partial*
 - *Analyst, chemist*
- 3) Connect terms with their spelling variants:
- *Technique & techniq*
 - *dialogue & dialog*
 - *Programme & program*
- 4) Divide terms into their component parts (prefixes, suffixes, roots) (Al-Jarf, 2019b; Al-Jarf, 2011b; Al-Jarf, 2011c; Al-Jarf, 2008a).
- *Electricity, gravity*
 - *Fundamental, partial, medical, biological, Biomedical*
 - *Fundamentals, essentials*
 - *Organic, dynamic, analytic*
 - *Analytics, dynamics, analytics, linguistics, mathematics*
 - *Scientist, geologist, chemist, analyst*
 - *Analysis, diagnosis, prognosis*
 - *Inorganic, anaerobic, displacement*
 - *Equilibrium*
 - *Heterogeneity, homogeneity*
 - *Multinational, monopoly; oligopoly.*
 - *Bureaucracy, democracy, autocracy, technocrat.*
- 5) Show which negative prefix a word takes: *Indifference, counterproductive, imbalance, irresponsible, illegal, amoral, immoral.*
- 6) Connect terms with other derivatives. Put derivatives together to form word families:
- *Compete, competitor, competition, competitive.*
 - *Analyze, analyst, analysis, analytics, analytical.*
 - *Employ, employer, employee, employment, employed, unemployed, unemployment.*
 - *Visual, vision, visualize, visualization, television.*
 - *Apply, application, applicant.*
 - *Bank, banker, banking.*
 - *Monopoly, monopolize, monopolistic.*

- 7) Connect terms with their part of speech:
 - *Fundamental (Adj), fundamentals (N).*
 - *Quantum, equilibrium, conductor, performance*
 - *Employment (N), employed (V, Adj), employer (N), employee (N)*
- 8) Connect terms with their singular or plural form (Al-Jarf, 2022a; Al-Jarf, 2020a):
 - *Dynamics, electronics, acoustics (all singular)*
 - *Species (sing), lorries (pl)*
 - *Data/datum, formula/formulae, analysis/analyses, stratum/strata; datum/data; bacterium/bacteria (sing/pl)*
- 9) Show if the noun is count or non-count, whether it is an action noun, a collective noun, a proper noun, an agent and so on (Al-Jarf, 2021j): *Network, resistance, electricity, contribution, Belbin team roles.*
- 10) Connect terms with their synonyms, and/or antonyms: *tension & stress; equilibrium & balance & counterbalance; heterogeneity & homogeneity; concave & convex; supply & demand; credit & debit.* Connect near synonyms together: *managing director, executive director, CEO, GM.*
- 11) Connect terms with their English definition and with their Arabic meanings: *Gravity, combustion chamber, equilibrium, trigonometry, molecule, unemployment.*
- 12) Show differences between similar terms in meaning and usage as in *personal & personnel, Human resources & personnel management.*
- 13) Explain words with multiple meanings and which meaning is used in a particular field such as *statement* (in common language, in grammar and banking); *depression* (in psychology and economics).
- 14) Show the meanings of idiomatic expressions such as *to be sacked, go broke, log off.*
- 15) Break compound terms into their components and show the meaning of the two parts as separate words and how the meaning changes when both parts are used as a compound. Sometimes, when the two words are separated, they become meaningless. For example: *outsourcing; self-actualization; scorecard & *score card; withdraw & *with draw; undertake & *under take; underwrite & *under write.*
- 16) Connect American and British varieties as in *"rent a car & hire a car; elevator & lift".*
- 17) Connect new terms with previously encountered terms.
 - *Mathematics, physics, acoustics, hydraulics, electronics, mechanics, dynamics, statics, statistics*
 - *Analysis, synthesis, hypothesis*
 - *Prognosis, diagnosis*
 - *Use visuals & concrete experiences to teach meaning*

3. Strategies for Teaching Multiple Associations:

ESP instructors can use a variety of instruction strategies for teaching multiple associations of technical terms in Business, Engineering, and Computer Science Purposes as in the following:

- (1) Follow a combination of systematic teacher-directed instruction in which the teacher is the primary deliverer of instruction and student-mediated instruction, in which the students are actively engaged in learning (Ariffin, 2021; González-Lloret, 2020; Stroud, 2014).
- (2) Provide active, meaningful, and repeated word use, combined with cooperative learning groups, i.e., the students perform activities collaboratively with their peers (González-Lloret, 2020; Al-Jarf, 2021a; Al-Jarf, 2009a).
- (3) Teach smaller sets of technical terms with cumulative, periodic review exercises.
- (4) Emphasize categorization, association, and visualization skills. For instance, teach related terms or words sharing the same root or suffix together: *bureaucracy, democracy, autocracy, aristocracy, technocrat, democrat.*
- (5) Use visuals such as pictures, drawings, illustrations, animations, graphic organizers such as infographs, Ven diagrams, mind-maps (concept maps) as in the example in Figure 1 in the Appendix to connect terms that share the same root,

suffixes or prefixes; show terms that share the same pronunciations, and terms that share the same spelling (Yawiloeng, 2020; Basal, Aytan & Demir, 2016; Al-Jarf, 2015a; Al-Jarf, 2011c; Al-Jarf, 2011d; Al-Jarf 2010;).

- (6) Integrate online videos with general topics in the students' major area to promote the students' background knowledge of specialized topics and familiarize them with technical terms in their field (Al-Jarf, 2022g; Al-Jarf, 2017; Al-Jarf, 2012b; Al-Jarf, 2011a).
- (7) Engage ESP students and motivate them with online vocabulary tasks (Al-Jarf, 2022c; Al-Jarf, 2021e; Al-Jarf, 2007; Stroud, 2014).
- (8) Encourage the students to review what they have learned in class frequently. The students can also actively participate in associative learning by using mobile vocabulary apps. They can create their own digital/mobile flash cards and use them for studying and reviewing technical terms (Zhang, 2014; Khazaie & Ketabi, 2011; Al-Jarf, 2022b; Al-Jarf, 2021g; Al-Jarf, 2020b; Al-Jarf, 2013).
- (9) Encourage the students to use a specialized online or mobile dictionary. Students learned more words while reading for meaning, but high verbal ability students and those using a dictionary learn more (Al-Jarf, 2022e; Al-Jarf, 2014; Mekheimer, 2018).
- (10) Encourage extensive reading of simplified books, mobile ebooks, mobile magazines and newspaper articles and analyze selected lexical items related to the students' area of specialty. They can also use and analyze vocabulary in specialized linguistic landscapes phonologically, morphologically, semantically, and orthographically (Al-Jarf, 2021a; Al-Jarf, 2021d; Al-Jarf, 2021h; Al-Jarf, 2012c; Al-Jarf, 2009b; Al-Jarf, 2009c).
- (11) Encourage extensive listening and speaking practice. The students may listen to mobile audiobooks, and TED talks, and podcasts about general topics in their area of specialization (Al-Jarf, 2021c; Al-Jarf, 2021f; Al-Jarf, 2021i; Al-Jarf, 2012a).
- (12) Integrate newly learnt technical terms in writing paragraphs, reports and blogs about specialized topics that are familiar to the students.
- (13) Teach mnemonic approaches to help students remember such as:
 - *Word Grouping*: Use both semantic and thematic groupings of terms; word organization strategies; and practicing technical terms in context
 - *The keyword method* such as associating a new L2 word with L1 keyword that is acoustically or orthographically similar and connecting L1 keyword with L1 translation of L2 word.
 - *Use of mental pictures* such as graphic organizer or semantic mapping to connect terms in a diagram (See Images 1 and 2).
- (14) Give periodic quizzes that focus on part of the material covered. Quizzes should require the students to make the above-mentioned associations. Technical terms can be assessed in isolation or in context. Quizzes and tests should be comprehensive in the types and amount of terms covered and should focus on assessing the students' breadth and depth of vocabulary knowledge, and knowledge of the multiple dimensions of the terms studied (Al-Jarf, 2021g; Al-Jarf, 2021j; Al-Jarf, 2015b).

4. Effect of the Multiple Associations Approach on Learning

The author used the multiple-associations instructional approach with groups of students learning ESP and general English vocabulary at the College of Languages of Translation, King Saud University and it proved to be effective in enhancing their general and specialized vocabulary. T-test results showed significant differences between the experimental and control groups' posttest means scores. Achievement (vocabulary development) in the experimental group was higher as a result of using the multiple-associations approach in general and specialized vocabulary instruction (Al-Jarf, 2006; Al-Jarf, 2007).

Finally, to help the students make further improvements in learning technical terms, the students' can be interviewed in small groups in which they examine and discuss details of their strategy use when learning technical terms inside and outside the classroom. Group interviews will raise students' awareness and provide them with an important opportunity to focus on their strengths and weaknesses in the language learning process.

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ORCID iD: <https://orcid.org/0000-0002-6255-1305>

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Appendix

Image 1: Types of drawings, illustrations, graphic organizers, infographs, Ven diagrams, mind-maps (concept maps for showing multiple associations among technical terms



Image 2: Connecting Car Parts and Their Terms



Source: <https://www.quora.com/What-is-this-term-interior-and-external-trim-in-automobile-industry>