
Authentic, Individualized Practice for English as a Second Language Vocabulary

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The REAP Tutor

- Intelligent Tutoring System for ESL Vocabulary Practice.
 - Provides authentic reading passages containing target vocabulary in context.
 - Gathers, filters, and selects from corpus of readings taken from Web.
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The REAP Tutor

- Students work through an individualized series of readings.
- Target words are highlighted.
- Definitions available for all words.
- Practice vocabulary exercises follow each reading.

The screenshot displays the REAP Tutor interface within a Mozilla Firefox browser window. The browser title is "ELI Reading - Mozilla Firefox" and the address bar shows "http://orleans.lti.cs.cmu.edu/eli4_f...". The main content area features a reading passage about a triathlete named Zhang. A pop-up window titled "http://orleans.lti.cs.cmu.ed..." displays the definition for the word "efficacy (n)": "an ability, especially of a medicine or a method of achieving something, to produce the intended result; effectiveness". Below the definition is a "Close" button. At the bottom of the browser window, there is a search bar containing the word "congested" and a "Look up a word" button. To the right of the search bar are two buttons: "This document did not show up properly at all" and "Done reading ->". The document ID "4511271 (web8m-20041116)" is visible at the bottom right.

top-notch bikes, plus the roads are always congested," says Zhang, who was a collegiate track star in Beijing before coming to the United States to attend Auburn University.

Zhang is training hard to become one of the few competitors to double in the Ironman Triathlon and Boston Marathon in the same year. 'I will suit up for China again,' he says. 'It is an honor to represent my own country.'

program covering the event. All kept their e
glimpse of Zhang.

Just three days earlier, he had defended his
performance of two cholesterol-lowering d
sequestrants. "Because of it **efficacy** probl
are needed to be effective," Zhang says. "So patient compliance is really
poor and may lead to **therapeutic** failure. We try to single out the reason
behind this and suggest strategy for improvements that would make the
therapy more effective and less costly."

efficacy (n)

- ◆ an ability, especially of a medicine or a method of achieving something, to produce the intended result; effectiveness

[Close](#)

Done

congested

Look up a word

This document did not show up properly at all

Done reading ->

Document ID: 4511271 (web8m-20041116)

Two Main Challenges

- Need to estimate set of words that the student most needs to learn.
 - Need to provide readings for effective practice of those words.
-

What words should REAP teach?

- REAP teaches from Academic Word List (Coxhead, 2000)
 - (However, not tied to particular list)

- Academic Word List has 570 head words

- abandon, abstract, academy, access, accommodate, accompany, accumulate, accurate, achieve, acknowledge, acquire, adapt, adequate, adjacent, adjust, administrate, adult, advocate, affect, aggregate, aid, albeit, allocate, alter, alternative, ambiguous, amend, analogy, analyse, annual, anticipate, apparent, append, appreciate, approach, appropriate, approximate, arbitrary, area, aspect, assemble, assess, assign, assist, assume, assure, attach, attain, attitude, attribute, author, authority, automate, available, aware, behalf, benefit, bias, bond, brief, bulk, capable, capacity, category, cease, challenge, channel, chapter, chart, chemical, circumstance, cite, civil, clarify, classic, clause, code, coherent, coincide, collapse, colleague, commence, comment, commission, commit, commodity, communicate, community, compatible, compensate, compile, complement, complex, component, compound, comprehensive, comprise, compute, conceive, concentrate, concept, conclude, concurrent, conduct, confer, confine, confirm, conflict, conform, consent, consequent, considerable, consist, constant, constitute, constrain, construct, consult, consume, contact, contemporary, context, contract, contradict, contrary, contrast, contribute, controversy, convene, converse, convert, convince, cooperate, coordinate, core, corporate, correspond, couple, create, credit, criteria, crucial, culture, currency, cycle, data, debate, decade, decline, deduce, define, definite, demonstrate, denote, deny, depress, derive, design, despite, detect, deviate, device, devote, differentiate, dimension, diminish, discrete, discriminate, displace, display, dispose, distinct, distort, distribute, diverse, document, domain, domestic, dominate, draft, drama, duration, dynamic, economy, edit, element, eliminate, emerge, emphasis, empirical, enable, encounter, energy, enforce, enhance, enormous, ensure, entity, environment, equate, equip, equivalent, erode, error, establish, estate, estimate, ethic, ethnic, evaluate, eventual, evident, evolve, exceed, exclude, exhibit, expand, expert, explicit, exploit, export, expose, external, extract, facilitate, factor, feature, federal, fee, file, final, finance, finite, flexible, fluctuate, focus, format, formula, forthcoming, found, foundation, framework, function, fund, fundamental, furthermore, gender, generate, generation, globe, goal, grade, grant, guarantee, guideline, hence, hierarchy, highlight, hypothesis, identical, identify, ideology, ignorant, illustrate, image, immigrate, impact, implement, implicate, implicit, imply, impose, incentive, incidence, incline, income, incorporate, index, indicate, individual, induce, inevitable, infer, infrastructure, inherent, inhibit, initial, initiate, injure, innovate, input, insert, insight, inspect, instance, institute, instruct, integral, integrate, integrity, intelligent, intense, interact, intermediate, internal, interpret, interval, intervene, intrinsic, invest, investigate, invoke, involve, isolate, issue, item, job, journal, justify, label, labour, layer, lecture, legal, legislate, levy, liberal, licence, likewise, link, locate, logic, maintain, major, manipulate, manual, margin, mature, maximise, mechanism, media, mediate, medical, medium, mental, method, migrate, military, minimal, minimise, minimum, ministry, minor, mode, modify, monitor, motive, mutual, negate, network, neutral, nevertheless, nonetheless, norm, normal, notion, notwithstanding, nuclear, objective, obtain, obvious, occupy, occur, odd, offset, ongoing, option, orient, outcome, output, overall, overlap, overseas, panel, paradigm, paragraph, parallel, parameter, participate, partner, passive, perceive, percent, period, persist, perspective, phase, phenomenon, philosophy, physical, plus, policy, portion, pose, positive, potential, practitioner, precede, precise, predict, predominant, preliminary, presume, previous, primary, prime, principal, principle, prior, priority, proceed, process, professional, prohibit, project, promote, proportion, prospect, protocol, psychology, publication, publish, purchase, pursue, qualitative, quote, radical, random, range, ratio, rational, react, recover, refine, regime, region, register, regulate, reinforce, reject, relax, release, relevant, reluctance, rely, remove, require, research, reside, resolve, resource, respond, restore, restrain, restrict, retain, reveal, revenue, reverse, revise, revolution, rigid, role, route, scenario, schedule, scheme, scope, section, sector, secure, seek, select, sequence, series, sex, shift, significant, similar, simulate, site, so-called, sole, somewhat, source, specific, specify, sphere, stable, statistic, status, straightforward, strategy, stress, structure, style, submit, subordinate, subsequent, subsidy, substitute, successor, sufficient, sum, summary, supplement, survey, survive, suspend, sustain, symbol, tape, target, task, team, technical, technique, technology, temporary, tense, terminate, text, theme, theory, thereby, thesis, topic, trace, tradition, transfer, transform, transit, transmit, transport, trend, trigger, ultimate, undergo, underlie, undertake, uniform, unify, unique, utilise, valid, vary, vehicle, version, via, violate, virtual, visible, vision, visual, volume, voluntary, welfare, whereas, whereby, widespread
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Individualizing Vocabulary Instruction

- Problem: Most students know completely different sets of words, depending on:
 - Courses, textbook,
 - Native language,
 - Real-world experience,
 - Different lengths of language study, etc.
 - Need to individualized instruction based on a list of words that the student does not know.
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Adaptive Tutoring

- Learner Modeling techniques such as Knowledge Tracing (Corbett & Anderson, 1995) can be used to estimate knowledge.
 - Can allow tutor to adapt its curriculum based on student performance.
 - Require performance/assessment data in order for instruction to be individualized.
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Challenges of Individualization

- Initially, no performance data is available.
 - Need list of ~100 unknown words to select optimal practice readings.
 - If only a short list, words may not occur together in REAP's corpus (e.g., “dimension,” “prohibit”)
 - Want to avoid texts with only one word.
 - Assessing each word is time-consuming.
 - Multiple-choice cloze questions take 30-60 sec.
 - (AWL has 570 items)
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A Self-Assessment Pre-test

- Need to *quickly* find unknown words.
 - REAP uses self-assessments on pre-test until it has a sufficiently long target word list.
 - “Do you know the word X?”
 - 5-10 seconds per word.
 - Can create list of ~100 unknown words in ~20 min.
 - Later, use learner modeling to adapt.
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Are Self-Assessments Accurate?

- Self-assessments:
 - Accurate when student claims that given word is **not** known.
 - **Not** accurate when student claims given word **is** known.
-

Two Main Challenges

- Need to estimate set of words that the student most needs to learn.
 - Need to provide readings for effective practice of those words.
-

Creating a Corpus of Readings

- REAP creates a corpus of readings from Web pages containing target words.
- Needs large corpus (10,000+ texts) for adequate coverage of words.
- Sends queries with sets of target words to search engines.
- Downloads, annotates, indexes the results offline.

(Collins-Thompson & Callan, 2004)

Constraints on Readings

- **General Constraints**
 - Mostly offline when corpus is created.
 - About 1% of texts remain after filtering.
 - **Specific Constraints**
 - Mostly online when students interact with REAP.
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General Constraints on Readings

- Reading level range (e.g., L1 grades 5-8)
 - Reading length (200-2000 words)
 - Inappropriate content
 - Duplicate content
 - Text Quality
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Reading Difficulty Measure

- Unigram language modeling approach to readability (Collins-Thompson and Callan, 2005).
 - Generative (naïve bayes) language model for each difficulty level.
 - For given text, finds closest model.
 - Trained from labeled dataset (English L1, ESL, French, etc.)
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Text Quality of Readings

- Many Web pages are just lists of products, navigation menus, tables.
 - Students need cohesive text in well-formed sentences and paragraphs.
 - Measures: language modeling, HTML syntax, whether text can be parsed.
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Specific Constraints

- Individual Target Word Lists
 - Personal Interests
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Individual Target Word Lists

- REAP must select texts from its corpus that contain a given student's unknown words.
 - Uses Lemur Search Engine Toolkit (www.lemurproject.org)
 - Challenge to find texts with ≥ 3 target words.
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Personal Interests

- Students see vocabulary words in contexts that interest them.
 - *Arts*: "For an artist who has **endured** so many years of obscurity..."
 - *Business*: "As California has **endured** a burst tech bubble, costly energy crisis and a staggering burden on its business community..."
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Personal Interests

- REAP uses SVM-Light toolkit (Joachims, 1999) to classify potential readings by topic.
 - Done offline when corpus is created.
 - Uses training data from general topic categories of Open Directory Project (dmoz.org).
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Personal Interests

- REAP prefers texts that match personal interests specified in a questionnaire.

Please mark which topics you want to see readings about.

Category	Examples	Not interested at all	Not very interested	Neither	Somewhat Interested	Very Interested
Arts	literature, movies, TV, music	<input type="radio"/>				
Business	investing, market, real estate	<input type="radio"/>				
Computers	hardware, software, Internet	<input type="radio"/>				
Games	video games, gambling	<input type="radio"/>				
Health	fitness, medicine, nutrition	<input type="radio"/>				
Home	family, cooking, gardening	<input type="radio"/>				
Recreation	travel, outdoors, boating	<input type="radio"/>				
Science	biology, astronomy, physics	<input type="radio"/>				
Society	politics, religion, sociology	<input type="radio"/>				
Sports	baseball, football, basketball	<input type="radio"/>				

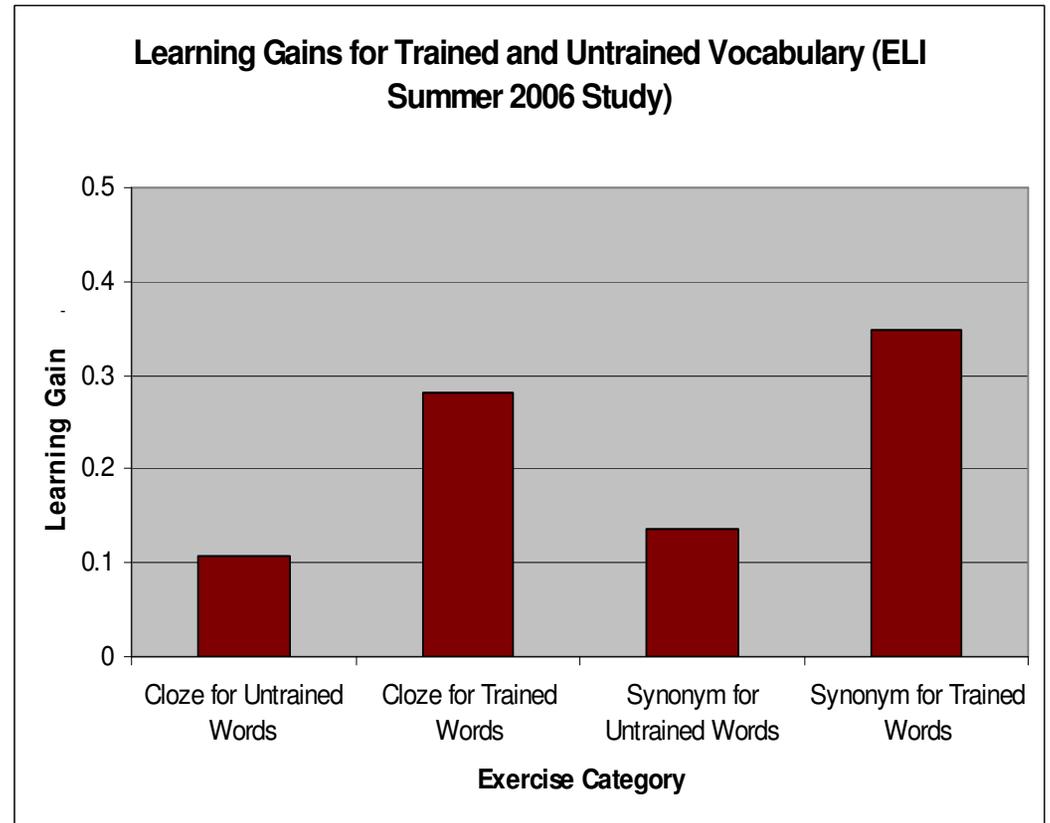
Continue

Usage of REAP

- REAP is currently used at English Language Institute at University of Pittsburgh
 - Used at ELI since Summer 2005
 - 2 reading classes of 25-50 students each
 - Part of Pittsburgh Science of Learning Center
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Learning Gains

- Higher post-test scores for practiced words than unpracticed.
- Currently analyzing results from study comparing REAP to classroom learning.

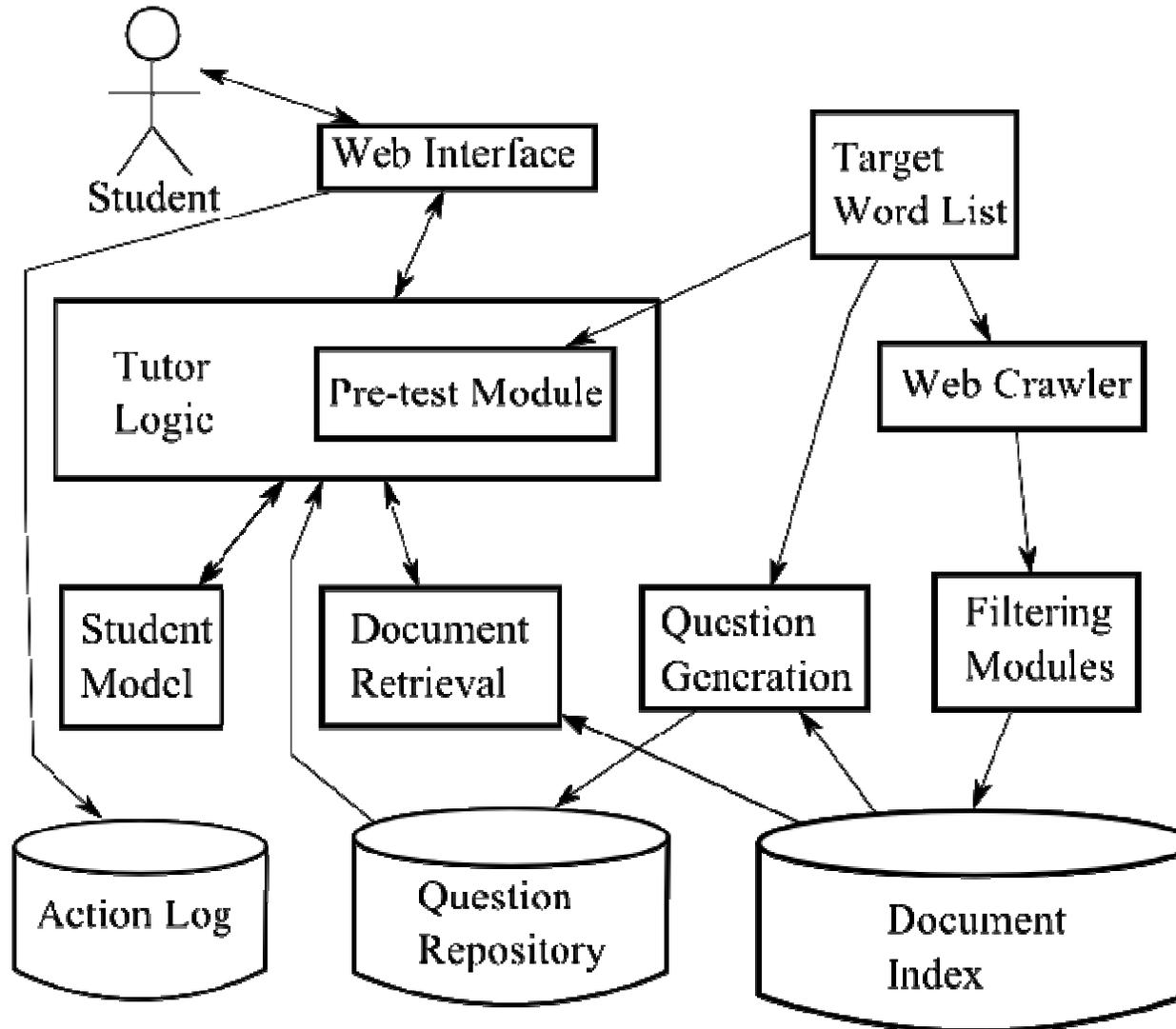


$$LG = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

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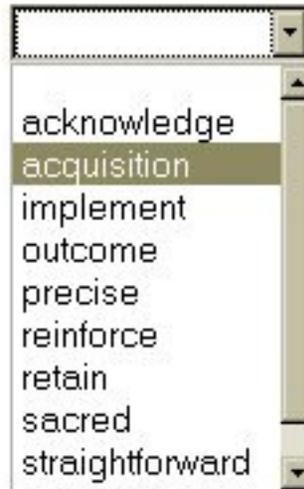
Logical Architecture



REAP Cloze Question Example

Select the word that best completes the phrase below:

The ___ of a few good players made the team better than they were the year before.



Approaches to Measuring Text Quality

■ HTML Formatting

- “Does text only appear in tables and links?”
- Problem: formatting varies by page’s author

■ Parsing

- “Can a parser find likely trees for the text?”
- Problem: full parsing is slow

■ Language Modeling

- “Do the sequences of parts of speech look like well-formed sentences?”
 - “article adjective noun verb” (good text)
 - “noun noun noun noun” (product list)
 - Problem: maybe not fine-grained enough
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