

The Benefits of Self-Explanation

Amber Settle

DePaul Faculty Teaching and
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What is self-explanation?

- Learners spontaneously explain the meaning of content
 - Passages of text or other written material
 - In the context of studying a target domain
 - Initially used in conjunction with worked examples
 - Notice relevant features of problem
 - Identify gaps in knowledge about the problem
- Quality of explanations differ
 - High quality: Inferences about missing material, integrative statements, deeper analysis of resources
 - Low quality: Simple paraphrasing of statements found in material

Self-explanation and learning

- High quality self-explanations are connected to learning gains
- Variety of disciplines
 - Math: algebra, geometry, logic
 - Natural science: physics, biology
 - Humanities: English, history
 - Computer science
 - Commonality: Need both ability to solve a problem and explain the underlying principles
- Variety of levels
 - Middle/high school
 - University
 - Adult learners
- What are some examples?

Biology

Background

- Middle-school (8th grade) students
 - Inner-city school
 - Volunteers
 - Not taken a biology course
- N = 24
 - Control group: 10
 - Experimental group: 14
 - Split equally by gender
- Problem: Read and understand a unit describing the human circulatory system
 - *Modern Biology* by Towle

Treatment

- 101-sentence passage
- Paper with one sentence per page
- Control group
 - [Read the passage twice](#)
- Experimental group
 - [General prompts](#)
 - After reading each sentence, prompted to explain what each sentence meant
 - [Specific prompts](#)
 - At 22 places prompts about specific functions of circulatory system
- Same time for both activities -- approximately 2 hours

Biology

Procedure

- Phase 1: Interview session (pre-test)
 - Describe 23 terms
 - Draw blood flow
 - Answered half of test questions
- Phase 2: Treatment session
 - Randomly assigned
 - One of the two situations
- Phase 3: Interview session (post-test)
 - Same as the first phase

Results

- Both groups of students gained significantly from the pre-test to the post-test
- The gain was greater for the prompted group (32%) than the unprompted group (22%)
 - On more difficult questions it was larger (22.6% prompted vs. 12.5% unprompted)
- High explainers ($M=61$) gained more (38%) than low explainers ($M=14$) (27%)
 - Also more pronounced for difficult questions (33% vs. 17%)

English

Background

- Adult ESL learners
- N = 118
- Single class session
- Problem: Second language grammar acquisition
 - Learning correct English article to use
 - a, an, the, none
 - Rule-based situation

Treatment

- Computerized tutoring system
 - Immediate feedback
- Article choice selection (tutored practice)
 - Choose article in a given sentence via a dropdown menu
- Explanation choice selection (self-explanation)
 - Shown the correct article, provide an explanation for it via a dropdown menu

Article choice

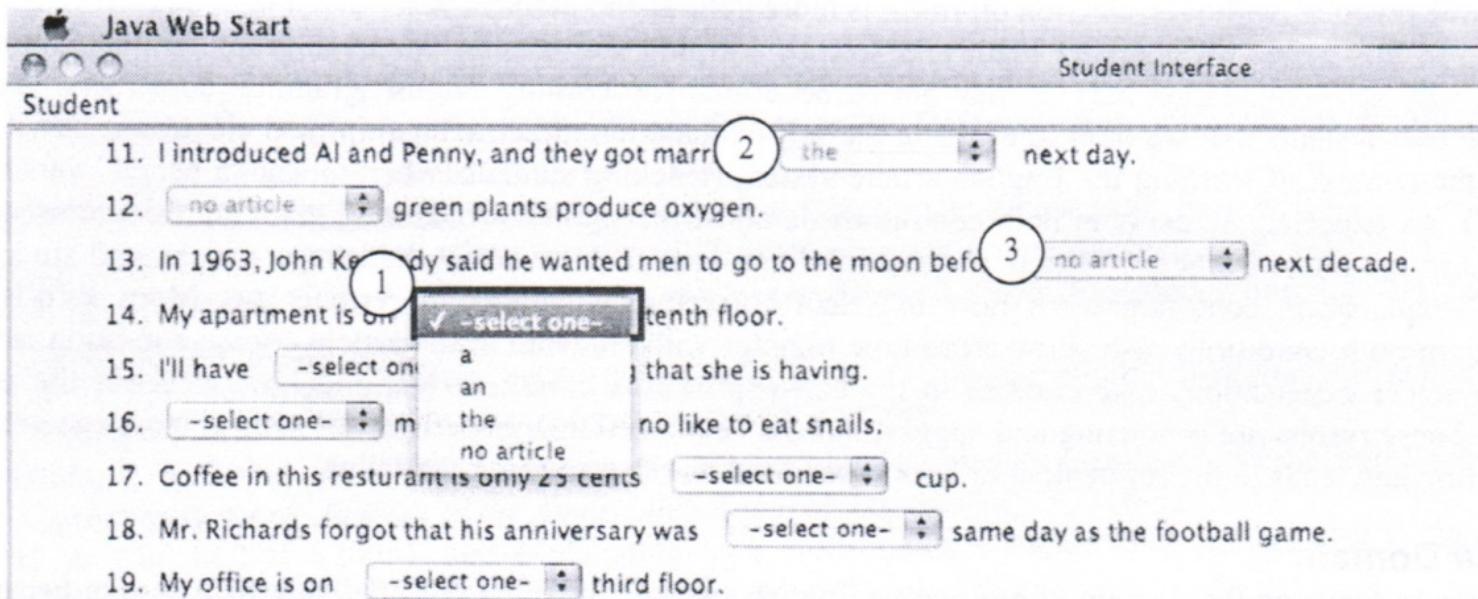
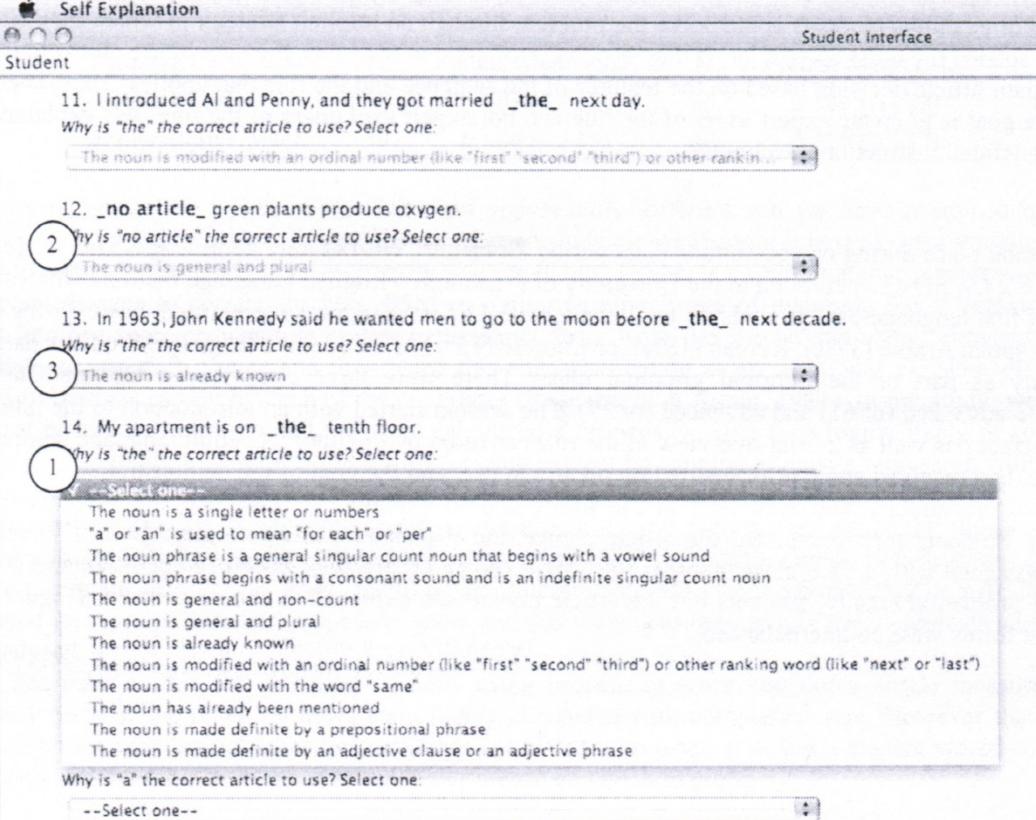


Figure 1. In the article choice condition, students choose the article (a, an, the, no article) that best completes the sentence (1), and receive immediate feedback on their selection. If the answer is right, it turns green (2), and red if it is wrong (3).

Explanation choice

A screenshot of a computer screen showing a "Self Explanation" window titled "Student Interface". The window displays four multiple-choice questions related to article use in sentences. Each question has a circled number indicating the correct answer: 1 (green), 2 (green), 3 (red). A scroll bar is visible on the right side of the window.

11. I introduced Al and Penny, and they got married the next day.
Why is "the" the correct article to use? Select one:
 The noun is modified with an ordinal number (like "first" "second" "third") or other ranking word

12. no article green plants produce oxygen.
Why is "no article" the correct article to use? Select one:
 The noun is general and plural

13. In 1963, John Kennedy said he wanted men to go to the moon before the next decade.
Why is "the" the correct article to use? Select one:
 The noun is already known

14. My apartment is on the tenth floor.
Why is "the" the correct article to use? Select one:
 --Select one--
The noun is a single letter or numbers
"a" or "an" is used to mean "for each" or "per"
The noun phrase is a general singular count noun that begins with a vowel sound
The noun phrase begins with a consonant sound and is an indefinite singular count noun
The noun is general and non-count
The noun is general and plural
The noun is already known
The noun is modified with an ordinal number (like "first" "second" "third") or other ranking word (like "next" or "last")
The noun is modified with the word "same"
The noun has already been mentioned
The noun is made definite by a prepositional phrase
The noun is made definite by an adjective clause or an adjective phrase

Why is "a" the correct article to use? Select one:
 --Select one--

Figure 2. In the explanation choice condition, students choose the feature of the sentence that best explains the article use (1). Identical to the article choice condition, students receive immediate feedback on their selection.

If the answer is right, it turns green (2), and red if it is wrong (3).

English

Procedure

- Pre-test
 - On both type of exercises
- Tutoring session
 - One type of activity only
 - Article choice exercises
 - or
 - Explanation choice exercises
 - Randomized assignment
- Post-test
 - On both types of exercises

Results

- Students improved on the type of problem they studied
- Students improved on the other type of problem (transfer)
- Effects of prompted self-explanation were somewhat stronger
- No reduction in speed for self-explanation group
 - Important for fluency

Computer science

Background

- Open University
 - Helsinki, Finland
 - Open enrollment for nominal fee (~\$50)
 - Summer 2013 and 2014
- N = 51
 - Initially N = 110
 - Typical dropout rate
- Problem: Java programming
 - Self-explanation exercises embedded into weekly course assignments
 - Longer-term than any previous study

Treatment

- Three weekly self-explanation exercises
- Two subgroups
 - Motivational text + code + self-explanation
 - Motivational text + code + multiple-choice question + self-explanation
 - Randomly assigned
- Self-explanations were not assessed for quality
 - Students knew this in advance

Computer science

Procedure

- Weekly course assignments
 - Between subjects design
- Final exam
 - Three self-explanation questions (0-2 points each for total of 0-6 points)
 - Compare Summer 2013 (no self-explanation) to Summer 2014 (with self-explanation)
 - Two of the three problem-based questions (0-11 points)
 - Ones with highest completion rate
 - Compare two Summer 2014 populations (with multiple-choice or without)

Results

- Students with self-explanation exercises ($M = 4.6$) performed better on self-explanation exam questions than previous year ($M = 3.7$)
 - Statistically significant
 - No evaluation of quality of explanations
- Students with supporting questions ($M = 8.4$) outperformed students without them ($M=6.7$)
 - Marginally significant
 - Focused students on relevant aspects of the question

Summary

- High quality self-explanations are connected to learning gains
- Subjects
 - Biology
 - English
 - Computer science
- Variety of levels
 - Middle school
 - University
 - Adult learners

References

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Contact me:

- Amber Settle
- asettle@cdm.depaul.edu
- <http://facweb.cdm.depaul.edu/asettle/>