Self-explaining in the Classroom: Learning Curve Evidence

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Abstract

Research conducted in the laboratory and classroom has repeatedly found that self-explaining is a useful, self-directed learning strategy. Although the self-explanation effect has been replicated several times, the sources for its effectiveness are still under investigation. The present study attempts to address the question: Why does self-explaining work? Two alternative proposals are contrasted. The content account proposes that self-explaining is effective because of the additional information to which the learner is exposed. Alternatively, the generation account suggests that it is the activity of producing an explanation that is effective. The evidence, taken from learning curves collected in the classroom, predominantly supports the generation account of self-explanation, which highlights the benefit of actively processing the learning material, instead of simply attending to it.

Introduction

Background

Self-explaining has been shown to be effective:

- In the laboratory (Azevedo, 2006; Chi, et al., 1989)
- In the classroom (Mishra, Loehr, & Anderson, 2004)
- With human prompting (Chen, DeLacava, Chi, & LeBaron, 1999)

Contrast is usually between self-explanation vs. none

- Not clear if the effect is due to additional content or the generation of the explanation itself.

Why does self-explaining work?

I. The content-account of self-explaining

- Additional content of instructional explanations drives self-directed learning (Chi, Stasz, Yavneh, & Henneman, 2003)
- Student-produced explanations drive (deep) learning, even when incorrect (Chen, 2003)

II. The generation-account of self-explaining

- Generation enhances an individual’s memory for:
  - Simple verbal-mental (Jenkins, 1978; Bergdahl & Graf, 1978)
  - Sentences (Kane & Anderson, 1978)
  - Tricks (Jenkins, 1978; Pappas and Murnan, 1990)
  - Conceptual material (Foss, Mist, & Fiacco, 1994)

Hypotheses

- Coverage hypothesis: paraphrase vs. self-explaining
- Generation hypothesis: paraphrase vs. self-explaining

Terminology

Knowledge Components

- Abstract units of knowledge: e.g., concepts, principles, rules, declarative knowledge, and schemata.

Learning Curves

- A visualization of initial performance and the rate of learning.

Method

Participants

- Midshipmen at the U.S. Naval Academy who received course credit for their participation (N = 104).

Design:

- Complete example / paraphrase (n = 26)
- Complete example / self-explain (n = 27)
- Incomplete example / paraphrase (n = 23)
- Incomplete example / self-explain (n = 28)

Materials

- Study instructions
- Video solutions to study
- Andes homework system
- Chapter exam (1 question)
- Homework (Near n = 8; Far n = 7)
- Study domain: electrodynamic
- Transfer domain: magnetism

Normal Learning Measures (DVs)

1. Near Transfer, Short-term Retention
2. Robust Learning Measures (DVs)
   - 1. Far Transfer (Electric Field Homework)
   - 2. Long-term Retention
   - 3. Accelerated Future Learning (Magnetic Homework)

Procedure

- Andes Physics Tutor

Transcript Example

- Transcript of student responses to Andes Physics Tutor questions.

Conclusions

1. At Knowledge Component

- The Incomplete self-explanation condition had lower assistance scores for all three knowledge components.
- Replicates findings from the aggregate level.

2. Most Knowledge Components demonstrated decelerating curves:

- According to most learning theories, errors and requests for assistance should decrease over time.
- This was evident in 2/3 knowledge components.

3. Knowledge Component Anomaly (KC2)

- Drawing an electric-force vector did not conform to the decelerating curve.
- Hypothesis: skill decomposition is wrong.
- Some KCs may be nested within others.
- Therefore, the assignment of blame is incorrect.

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For further information

Please contact sobhaus@pitt.edu for more information on this and related projects. A copy of the poster is located on http://www.pitt.edu/~bobhaus/pubs.html