Exposing the Learning-by-Teaching Process Through Concept Maps
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Introduction

Learning-by-Teaching

- There is much inconsistency in teachers’ roles in learning-by-teaching research.
- Meta-analytic evidence has shown that tutoring is an effective learning activity (Cohen, Kulik, & Kulik, 1982). However, little research has examined the learning outside of tutoring. Tutors typically have more prior knowledge and also may learn more from interactions with tutees.
- Bargh and Schul (1980) were the first to define 3 stages of the learning-by-teaching process, as summarized in Figure 1.

Some research has found that simply preparing to teach can produce advantageous results to taking a test (Benware & Deci, 1984; Fiorella & Mayer, 2013; Nestjo et al., 2014). Research has therefore noted a need to further examine the cognitive processes that are occurring while preparing to teach.

Concept Mapping

- Fiorella and Mayer (2013) measured stage 2 in the process by having teachers explain on video. After a one-week delay, those who taught better performed on the post-test than those who prepared to teach and prepared to test. This is likely because generative learning techniques, such as teaching, are most effective after time delays.
- Fiorella and Mayer (2014) attempted to examine the interaction between preparing to teach and teaching. They found that those who expected to teach and did teach had the highest performance of all groups.
- Teachers tend not to engage in deep cognitive processing and often summarize or memorize rather than use generative learning techniques, such as regulating and assessing their learning (Roscoe & Chi, 2007, 2008).

Hypotheses

The proposed study will incorporate concept maps into learning-by-teaching experimentation to determine the cognitive organization that is occurring while preparing to teach, as well as to increase the effectiveness of teaching by enabling teachers to engage in deeper processing through mapping.

- H1: There will be a main effect of teaching on learning and retention scores.
- H2: There will be a main effect of concept mapping on learning and retention scores.
- H3: Those who teach will show more accurate and complete concept maps than those who do not teach.
- H4: The main effect of teaching on learning will depend on the effect of concept mapping, such that the effect is stronger when a concept map is used and weaker when a concept map is not used.

Concept Mapping

- Concept mapping has been shown to be effective by fostering generative learning. A review of 25 studies utilizing concept mapping tests and knowledge tests found positive effects of concept mapping versus other learning activities with an effect size of $d = 0.62$ (Fiorella & Mayer, 2015).

A meta-analysis explored the use of concept maps and talking aloud while preparing to teach and found those who used more self-regulatory strategies, such as assessing knowledge and goal setting, developed better concept maps and learned more.

- Concept mapping has been shown to be even more beneficial for low-performing students (e.g., Haugwitz, Nesbit, & Sandmann, 2010; Liu, Chen, & Chang, 2010; Stensvold & Wilson, 1990). A meta-analysis found an effect size of $d = 0.44$ for low verbal ability students versus $d = 0.33$ for high verbal ability students (Nesbit & Adesope, 2006).

Methods

Experimental conditions:
- 1. Only Testing
- 2. Teaching
- 3. Concept Mapping
- 4. Teaching and Concept Mapping

Participants:
- Participants will be students from General Psychology and Social Psychology at Middle Tennessee State University.
- They will receive extra credit in their courses for participating.
- The target sample size is 100 participants.

Part One:
- Participants will be randomly assigned to one of the four conditions.
- All participants will take a pre-comprehension test.
- Teachers will record their lessons on video, as if they would be watched by a learner later.
- The time for reading, concept mapping, and teaching will be adjusted in each condition so that each participant has a total of 25 minutes’ time with the learning material. For example, condition 4 will read for 10 minutes, then concept map for 10 minutes, and then record their lesson for 5 minutes.
- Participants will then take a different form of the same comprehension test.

Part Two:
- The proposed study will extend that of Fiorella and Mayer (2014) to measure retention after one month rather than after one week. Participants will return to the study approximately 4 weeks after part one.
- Participants will take a different form of the same comprehension test.
- A post-experimental survey will be given measuring demographic information such as GPA, class standing, age, and gender.

Participants’ concept maps and 3 comprehension tests will be scored with a rubric.

Analysis Plan

A 2x2 ANCOVA will be utilized with teaching condition (teaching or no teaching) and concept mapping (mapping or no mapping) as between-subjects factors.

Participants’ reading ACT scores will serve as a covariate based on previous research (Haugwitz, Nesbit, & Sandmann, 2010; Liu, Chen, & Chang, 2010; Stensvold & Wilson, 1990) finding concept maps more beneficial for students with lower verbal ability.

Pre-comprehension test scores will also serve as a control.

Means between the three comprehension tests will be compared to determine changes over time.

Discussion & Implications

- If the combination of teaching and concept mapping shows the greatest learning and retention benefits, it would be advantageous to utilize both activities in learning settings.
- The learning-by-teaching method has shown success in a variety of settings, such as education (Grzegor & Schiter, 2008), medical and nursing training (Gregory, Walker, McLaughlin, & Peets, 2011), and the workplace (Cortesse, 2005). The method could be utilized in additional settings, such as formal school curriculums and on-the-job training programs in organizations.
- Future research should examine the effectiveness of the method in these various settings and with different populations.
- Future research should examine and compare Stages 2 and 3 in the process (explaining and interactions), as the present research only examines Stages 1 and 2 (preparing to teach and explaining).

References


Mayer, R. E. (2005). The method could be utilized in additional settings, such as formal school curriculums and on-the-job training programs in organizations.


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Stensvold, R., & Wilson, M. W. (1990). The method could be utilized in additional settings, such as formal school curriculums and on-the-job training programs in organizations.

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