Learning by Teaching:
When passive observing through a medium can be more effective than doing

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Abstract
In this study, forty adult participants tested the hypothesis that an important aspect of learning-by-teaching is the opportunity to observe one’s student perform. Participants studied a passage on the body’s mechanisms for causing fever. They then completed one of four conditions. (a) Teach and then observe their student answer questions. (b) Teach and then self-study a set of questions oneself. (c) Self-study and then observe a student answer questions. (d) Self-study and then self-study again. Results indicated that teaching and observing one’s student led to greatest learning gains both for the questions one’s student tried to answer and new questions that had not been raised. In some cases, it is better to observe than do.

Introduction
Learning by doing is often said to be an optimal way to help students learn. Underneath its umbrella, one can find variants that range from constructionism (Kafai & Harel, 1991), problem-solving (Anzai & Simon, 1979), and project-based learning (Krajcik, 2001). People also develop a sense of a problem space when they have open-ended exploration (Vollmeyer et al, 1978). However, for our purposes, the key contrast is between “learning by doing something oneself” versus “learning by observing somebody else do the same thing.” Are there situations where learning by observing can be superior? Social psychology includes many cases where people learn by watching and imitating others (Bandura, 1977; Meltzoff, 2002). Other areas include observing a particular medium, like learning from a video/televised recording (Kozma, 1991).

While many may see active doing and passive observation as being at opposite ends of contrasts, we argue that this may be a mistake and that observation is an integral part of one another. The question we pose is whether there are situations where observing another person through a medium is actually a more effective way to learn than doing the same thing oneself? And if so, what are the types of learning content and conditions that make this possible. We stress that “observing” can be more effective than “doing”, especially when the observation is part of a reflective-productive relationship. However, learning by observation usually does not deal with conceptual topics where most educators need to teach relations among abstract ideas. Also observing seems to be better than doing when a person cannot perform the task, but when the other person you observe can (expert models). For this reason we hypothesized that an important aspect of learning-by-teaching is the opportunity to watch one’s student perform. Learning by teaching (Bargh & Schul,1980; Schwartz et al, in press) forms a giving and receiving relation, producing ideas through one another, and then allowing one to observe how that production (performance of student) takes form.

We have further explored this relationship in a study where forty adult participants tested the hypothesis that an important aspect of learning-by-teaching is the opportunity to watch one’s student perform. This reflection/prodution will allow participants to gain information about their ability (Weiner, 1985) allowing one to effectively learn from a medium.

The study consists of four conditions created by crossing the two factors of Teach and Observe. As seen in Figure 1 below, the four conditions include (a) Teach and then observe their student answer questions, (b) Teach and then self-study a set of questions oneself, (c) Self-study and then observe a student answer questions, and (d) Self-study and then self-study again.

Methods
Participants completed the study individually. In session 1, participants were told that they had 10 minutes to read a one-page passage and prepare to tutor a student on the fever passage. Participants had the passage at their disposal throughout the study, except during posttest. After preparing, participants entered their experimental condition. In session 2 for the Teach factor, which occurred first, participants either taught Student X or studied the passage worked on their own (Teach v. Do-Self). In session 3 for the Observe factor, which occurred second, participants either observed Student X answer some questions, or they answered the questions themselves (Observe v. Do-Self).

Figure 1: Study Design
During session 2 participants worked with Question Set A. During the session 3, students worked with Question Set B. Participants never received feedback on any answers given on the Questions Sets. Afterwards, participants completed a post test by answering Question Set A, Question Set B, and a new Question Set C.

The fever passage explained mechanisms that trigger the fever response in humans (e.g., macrophages), the mechanisms that introduce more heat into the body (e.g., shivering), and the mechanisms that prevent the body from releasing heat (e.g. withhold sweat). Each Question Set had five questions. Question Sets A and B were largely factual (e.g. “Why is shivering not enough to create a fever?”). Question Set C used inference questions (e.g. “Imagine that there are no pathogens in your body and your body temperature is normal. If you take an aspirin, your body will not cool down. Why not?”). We scored each question on 0 to 2 point scale, as seen in Table 1, thus for any Question Set, the maximum score is 10.

### Table 1: Scoring Method

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>incorrect or no answer</td>
</tr>
<tr>
<td>1</td>
<td>partially correct but incomplete</td>
</tr>
<tr>
<td>2</td>
<td>precise and detailed</td>
</tr>
</tbody>
</table>

**Why do your hands and feet get cold with a fever?**

- 0 point: “Because you sweat and that cools the hands”
- 1 point: “Because blood veins shrink and less blood gets near the skin.”
- 2 points: “Because of a process called Vascularization, where the blood near the veins shrink and less blood gets near the skin and cannot release as much heat through the skin.”

### Results

First, we found that teaching other students around a set of questions led to gains compared to just working on those problems oneself. As seen in Figure 2, these results are seen even though the confederate student did not contribute very much information in the teaching interaction. Notably, the benefits of teaching lasted into the later portions of the study, so that even the teaching participants who subsequently studied on their own (instead of observing) showed advantages on questions from the later parts of the study. Thus, the results support the basic idea that interacting with a pupil can be helpful for learning. Second, we found that teaching and then observing one’s pupil has powerful effects on what one learns. The Teach+Observe condition started to truly separate itself on Question Set B. Interestingly, the benefits carried over to the questions in Set C. This suggests that the Teach+Observe participants had developed a fuller model of the fever’s temperature regulation. Importantly, the students in the Do-Self+Observe condition observed the same video of the student working on Question Set B. However, they showed minimal benefits for observing compared to the otherwise comparable students who worked on Question Set B themselves (the Do-Self+Do-Self condition). Evidently, the participants who had taught their student had been prepared to learn by observing their pupil student subsequently.

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## Reference


