VISUALIZING THOUGHT IN MEDICAL EDUCATION:
How Does Drawing Enhance the Learning of Diagnostic Skills in Radiology?

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Abstract

Studies in the learning sciences suggest that **drawing** may prove useful for **reflection**, as a **learning diagnostic**, and as a **cognitive tool**.[1] A study has been designed to determine if drawing at different times while learning with an application on radiograph interpretation (**Figure 1**) will improve learning and **cognition**. The research is ongoing, and new qualitative data reveals various uses for drawing dependent on the timing of the drawing activity.

Figure 1. The ImageSIM fracture identification application.

Introduction & Purpose

In medicine, interventions allowing for efficient learning, better retention, and mastery are needed to improve patient outcomes. Although studies using art in medical training exist, few have explored learner-made drawings as an option.[2] The present study aims to address these questions with regard to drawing in medical education:

- **(a)** Can drawing during radiograph interpretation improve learning?
- **(b)** Does the timing of a drawing impact its effectiveness?
- **(c)** Which covariates moderate the effects of drawing on learning?

Materials & Methods

Participants are asked to **(a)** complete a survey on learner variables and a visuo-spatial task, and then **(b)** draw while identifying fractures in a series of radiographs from 40 cases within a learning app. This study has a **2x2 factorial design** with **three treatments**, each with 35 medical students (**Figure 2**). A **control group** performs the fracture task without drawing.

"Think alouds" from a small subset (N=20) are recorded and transcribed for the **qualitative pilot**. Materials for the pilot include surveys, a **fracture task learning app** (**Figure 1**), recording tools, and drawing materials.

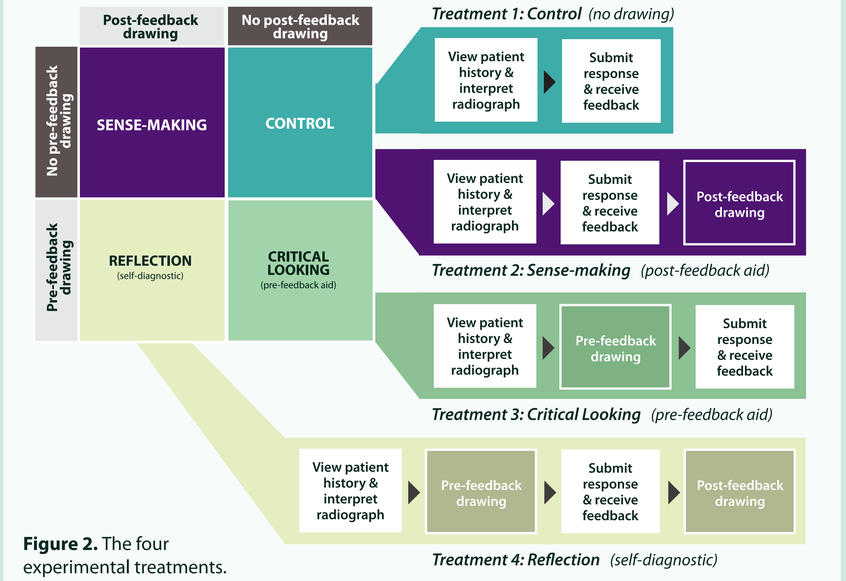

Figure 2. The four experimental treatments.

Pilot Results: "Think Aloud" & Qualitative Trends

Treatment 3: Critical Looking

Drawing as a Rehearsal of Ideas
"It looks like there's a linear fracture at the base of the humerus … I'm drawing that in. So there's a fracture, maybe."

Drawing as a Backup Notation
"I drew the line because just in case that was a fracture … I've never seen an intra articular fracture before." (**Figure 3**)

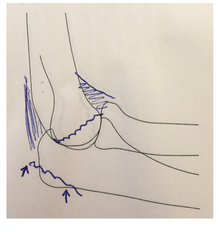

Figure 3. Pre-feedback drawing

Pilot Results: Qualitative Trends, *(cont'd)*

Treatment 2: Sense-making

Drawing as a Check for Completeness
"Am I supposed to draw what I see or what [the feedback] shows me? I did not see that at all, but now I do." [draws fracture]

Drawing as a Learning Exercise
"I'm going to draw this piece of the olecranon to learn that it's normal." (**Figure 4**)

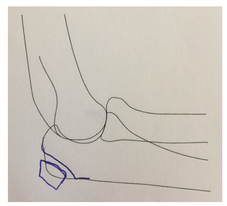

Figure 4. Post-feedback image.

Treatment 4: Reflection

Drawing to Amend Understandings
"I'm going to draw the lines that I thought were normal … so that I remember that the next time."

Additional visual example (**Figure 5**).

Drawing as a Memory Aid
"Maybe it's normal, but I'm going to draw it anyway because it stuck out … I can interpret [it] next time as a fracture."

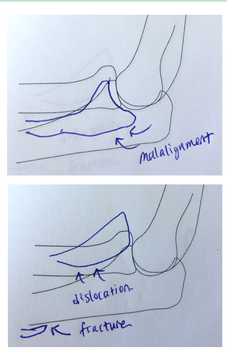

Figure 5. Pre-feedback (*above*) & post-feedback (*below*) image.

Discussion & Conclusions

The timing of a drawing impacts its role and utility as a cognitive aid during learning. The forthcoming quantitative analyses and learning curves may determine which timings improve learning outcomes across learner variables.

Bibliography

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