An Evidence-Based Approach to Teaching in the OR.

Nirupan Vipulanathan
I TAUGHT STRIPE HOW TO WHISTLE

I DON'T HEAR HIM WHISTLING

I SAID I TAUGHT HIM. I DIDN'T SAY HE LEARNED IT
Introduction to learning theories
How to teach in the OR
Why do some innovations spread so swiftly and others so slowly? Consider the very different trajectories of surgical anesthesia and antiseptics, both of which were discovered in the nineteenth century. The first public demonstration of anesthesia was in 1846. The Boston surgeon Henry Jacob Bigelow was approached by a local dentist named William Morton, who insisted that he had found a gas that could render patients insensible to the pain of surgery. That was a dramatic claim. In those days, even a minor tooth extraction was excruciating. Without effective pain control, surgeons learned to work with slashing speed. Attendants pinned patients down as they screamed and thrashed, until they fainted from the agony. Nothing ever tried had made much difference. Nonetheless, Bigelow agreed to let Morton demonstrate his claim.

On October 16, 1846, at Massachusetts General Hospital, Morton administered his gas through an inhaler in the mouth of a young man undergoing the excision of a tumor in his jaw. The patient only muttered to himself in a semi-conscious state during the procedure. The following day, the
Sister Seema Yadav, a twenty-four-year-old, round-faced nurse three years out of school, was one of the trainers. (Nurses are called “sisters” in India, a carryover from the British usage.) Her first assignment was to follow a thirty-year-old nurse with vastly more experience than she had. Watching the nurse take a woman through labor and delivery, she saw how little of the training had been absorbed. The room had not been disinfected; blood from a previous birth remained in a bucket. When the woman came in—moaning, contractions speeding up—the nurse didn’t check her vital signs. She didn’t wash her hands. She prepared no emergency supplies. After delivery, she checked the newborn’s temperature with her hand, not a thermometer. Instead of warming the baby against the mother’s skin, she handed the newborn to the relatives.

When Sister Seema pointed out the discrepancy between the teaching and the practice, the nurse was put out. She gave many reasons that steps were missed—there was no time, they were swamped with deliveries, there was seldom a thermometer at hand, the cleaners never did their job. Sister Seema—a cheerful, bubbly, fast talker—took her to the cleaner on duty and together they explained why cleaning the rooms between deliveries was so important. They went to the medical officer in charge and asked for a thermometer to be supplied. At her second and third visits, disinfection seemed more consistent. A thermometer had been found in a storage closet. But the nurse still hadn’t changed much of her own routine. [cartoon id="a17195"]
By the fourth or fifth visit, their conversations had shifted. They shared cups of chai and began talking about why you must wash hands even if you wear gloves (because of holes in the gloves and the tendency to touch equipment without them on), and why checking blood pressure matters (because hypertension is a sign of eclampsia, which, when untreated, is a common cause of death among pregnant women). They learned a bit about each other, too. Both turned out to have one child—Sister Seema a four-year-old boy, the nurse an eight-year-old girl. The nurse lived in the capital, a two-hour bus ride away. She was divorced, living with her mother, and struggled with the commute. She’d been frustrated not to find a hospital posting in the city. She worked for days at a stretch, sleeping on a cot when she got a break. Sister Seema commiserated, and shared her own hopes for her family and her future. With time, it became clearer to the nurse that Sister Seema was there only to help and to learn from the experience herself. They even exchanged mobile-phone numbers and spoke between visits. When Sister Seema didn’t have the answer to a question, she made sure she got one.

Soon, she said, the nurse began to change. After several visits, she was taking temperatures and blood pressures properly, washing her hands, giving the necessary medications—almost everything. Sister Seema saw it with her own eyes.
child was to be bundled against the mother’s skin. But, step by step, Sister Seema had helped her to do it. “She showed me how to get things done practically,” the nurse said.

“Why did you listen to her?” I asked. “She had only a fraction of your experience.”

In the beginning, she didn’t, the nurse admitted. “The first day she came, I felt the workload on my head was increasing.” From the second time, however, the nurse began feeling better about the visits. She even began looking forward to them.

“Why?” I asked.

All the nurse could think to say was “She was nice.”

“She was nice?”

“She smiled a lot.”

“That was it?”

“It wasn’t like talking to someone who was trying to find mistakes,” she said. “It was like talking to a friend.”
Active Learning vs. Passive Learning

What’s the difference?

*Education Research
  Variable Intervention
  Large # of uncontrollable factors
  Small N
Haidet et al. 2004

82 Baylor residents in 6 specialties learning stats
60 min lecture vs. 30 min lecture + active learning

*P value for effect of group assignment on change in scores = 0.67; N = 65 for pre and post test, N = 57 for one-month followup.

Figure 1. Knowledge assessments between study groups. *

* Sens/spec = sensitivity/specificity attitudes; pred val = predictive value attitudes. P values for effect of group assignment on changes in attitudes over time are 0.22 for sens/spec attitudes and 0.68 for pred val attitudes.
** Higher scores indicate more favorable attitudes toward the content area assessed. Possible scores for sens/spec attitudes range from 6–30; possible scores for pred val attitudes range from 5–25.

Figure 2. Attitude assessments between study groups.
Freeman 2014

225 studies
Average performance increase 0.47 SD
Risk Ratio 1.5 for failure in Traditional groups

Learning Theory
- Active vs. Passive
- Psychological Safety
- Forgetting Curve + Spaced Repetition
- Bloom’s Taxonomy
- Self-Determination Theory
- Circle of Learning
- Teach in OR
### Mean Scores

<table>
<thead>
<tr>
<th></th>
<th>Achievement Test. Short-term retention</th>
<th>Post-Test. Long-term retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group</td>
<td>78.1%</td>
<td>70.6%</td>
</tr>
<tr>
<td>Control Group</td>
<td>71.9%</td>
<td>54.25%</td>
</tr>
</tbody>
</table>

*TABLE 1: Short-term retention vs. long-term retention*

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Perez-sabater et al. 2011

32 foreign students learning English

Retention 8m later
Kvam 2000

23 vs. 15 students Engineering Stats Course
Tested 8m later
Why do some innovations spread so swiftly and others so slowly? Consider the very different trajectories of surgical anesthesia and antiseptics, both of which were discovered in the nineteenth century. The first public demonstration of anesthesia was in 1846. The Boston surgeon Henry Jacob Bigelow was approached by a local dentist named William Morton, who insisted that he had found a gas that could render patients insensible to the pain of surgery. That was a dramatic claim. In those days, even a minor tooth extraction was excruciating. Without effective pain control, surgeons learned to work with slashing speed. Attendants pinned patients down as they screamed and thrashed, until they fainted from the agony. Nothing ever tried had made much difference. Nonetheless, Bigelow agreed to let Morton demonstrate his claim.

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Applied to your resident

Pimping
Discussion
Teacher reversal
Oral exams
→ Individualizes learning
*Needs a homogenous learner

Bloom 1984
Socratic Method
Facilitate questions with Psychological Safety

Pimping - what's the point of it?
Formative vs. summative

Need to feel safe to ask stupid questions
This paper presents a model of team learning and tests it in a multimethod field study. It introduces the construct of team psychological safety—a shared belief held by members of a team that the team is safe for interpersonal risk taking—and models the effects of team psychological safety and team efficacy together on learning and performance in organizational work teams. Results of a study of 51 work teams in a manufacturing company, measuring antecedent, process, and outcome variables, show that team psychological safety is associated with learning behavior, but team efficacy is not, when controlling for team psychological safety. As predicted, learning behavior mediates between team psychological safety and team performance. The results support an integrative perspective in which both team structures, such as context support and team leader coaching, and shared beliefs shape team outcomes.

A growing reliance on teams in changing and uncertain organizational environments creates a managerial imperative to understand the factors that enable team learning. Although much has been written about teams and about learning in organizations, our understanding of learning in teams remains limited. A review of the team effectiveness and organizational learning literatures reveals markedly different approaches and a lack of cross-fertilization between them. An
Google

Internal review of >180 google teams looking at 250 attributes

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Teach in OR
Figure 2. Interaction effect between team priority of safety and psychological safety on the reported number of treatment errors.

Leroy et al. 2012

54 nursing teams

Strong correlation between psychological safety and reported errors
Raw means show that some student characteristics predict which students report a dominator and being comfortable in their group.

A) Students who have low course grades report higher levels of a dominator; B) International students (Int) and Asian-American students (AsAm) report higher levels of a dominator than white students (Wht), and there is no difference in dominator report rate between white students and URM students; C) The single predictor determining a student’s comfort in their group was whether (or not) they worked with a friend. Error bars indicate standard error and are present on all plots, despite being very small and subsumed by points in some cases. See Table 2 for final models and modeled estimates.

Theobald et al. 2017
776 undergrad biology students
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Applied to your resident

Difficult when evaluator = teacher
*HS/ugrad relatively separated
Forgetting Curve and Spaced Repetition

Hermann Ebbinghaus' forgetting curve
100% of information retained
20 minutes
1 day
31 days

Ebbinghaus 1885
Supermemo algorithm

21st century quiz banks and apps

Theory of forgetting is necessary
Testing is a form of learning

Roediger and Karpicke 2006

250 word passages ugrad
5 min read or test
Figure 3. Study design comparing different approaches to promote retrieval practice. Derived from Smith and Karpicke, 2014.

Figure 4. Different question formats can promote test-enhanced learning. Derived from Smith and Karpicke, 2014.
Butler and Roediger 2008

25 question test
Immediate = after test question
Delay = after whole test

Figure 5. Feedback enhances the effects of retrieval practice. Derived from Butler and Roediger, 2008.
By the fourth or fifth visit, their conversations had shifted. They shared cups of chai and began talking about why you must wash hands even if you wear gloves (because of holes in the gloves and the tendency to touch equipment without them on), and why checking blood pressure matters (because hypertension is a sign of eclampsia, which, when untreated, is a common cause of death among pregnant women). They learned a bit about each other, too. Both turned out to have one child—Sister Seema a four-year-old boy, the nurse an eight-year-old girl. The nurse lived in the capital, a two-hour bus ride away. She was divorced, living with her mother, and struggled with the commute. She'd been frustrated not to find a hospital posting in the city. She worked for days at a stretch, sleeping on a cot when she got a break. Sister Seema commiserated, and shared her own hopes for her family and her future. With time, it became clearer to the nurse that Sister Seema was there only to help and to learn from the experience herself. They even exchanged mobile-phone numbers and spoke between visits. When Sister Seema didn't have the answer to a question, she made sure she got one.

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This is expected, don’t be disappointed.

This isn’t the residents’ fault.
Applied to your resident

Needs to be topics they know
Topic ahead of time – article, video, chapter
Smaller topic – not efficient but better retention
Sleep
Interleaved
Bloom’s Taxonomy

Bloom 1948
34 University professors
Learning Theory

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Bloom 1948

34 University professors
Applied to your resident

Teach ‘application’ and ‘analysis’

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Ryan and Deci 2000
Applied to your resident

Relatedness - psychological safety
Competence - pre-reading
Autonomy
Circle of learning

1. Unconsciously incompetent (naïveté)
2. Consciously incompetent
3. Consciously competent
4. Unconsciously competent (mastery)

Mastery

 Consciousness

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Teach in OR
Dunning and Kruger 1999

Figure 2. Perceived logical reasoning ability and test performance as a function of actual test performance (Study 2).

Table 1
Self-Ratings (Percentile Scales) of Ability and Performance on Test Before and After Grading Task for Bottom- and Top-Quartile Participants (Study 3, Phase 2)

<table>
<thead>
<tr>
<th>Participant quartile</th>
<th>Bottom</th>
<th>Top</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Percentile ability</td>
<td>Percentile test score</td>
</tr>
<tr>
<td>Before</td>
<td>66.8</td>
<td>60.5</td>
</tr>
<tr>
<td>After</td>
<td>63.2</td>
<td>65.4</td>
</tr>
<tr>
<td>Difference</td>
<td>-3.5</td>
<td>4.9</td>
</tr>
<tr>
<td>Actual</td>
<td>10.1</td>
<td>10.1</td>
</tr>
</tbody>
</table>

*p < .05. **p < .01.
Applied to the OR

Pre-reading - spaced repetition
  Clarifies expectations – junior needs more guidance/resource curation
  Slow removal of support
    *this is for knowledge as well as skill sets which we already do for procedures

Ask them - active learning
  ‘pimp’ but for a purpose - remember FORMATIVE, and to inform what you teach next
  Form of ‘testing’

Smaller topics

Make it Application – Bloom’s taxonomy

Give them Autonomy - SDT

Psychologically safe!! - they need to feel safe
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