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Applying Design-Thinking In Didactic ActivitieS (ADIDAS)

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ABSTRACT

Background: Although didactic lectures are a common medical education teaching method, data suggest long term retention is minimal.

Objective: Design thinking as a potential means to improve a didactic session on operating room (OR) equipment and safety is explored here.

Methods: During a 2021 didactic session for five CA-1 residents, a faculty member structured a design activity on OR equipment and safety. The residents were asked to build an OR rapid prototype using office supplies. They were given ten minutes to brainstorm, followed by thirty minutes to build.

Results: General feedback from residents (60% response rate) was positive, reporting increased knowledge and engagement.

Conclusions: This activity required the residents to think critically about the functions of anesthesia machines from multiple perspectives, including patient safety and clinician needs. The design thinking process may help the residents better retain information, understand, and engage with the purpose of each item in the OR. Efficacy in future iterations will be through resident ITE score gaps in this topic. Future studies should ascertain the applicability of this learning format to specific didactic lectures.

KEYWORDS: design thinking, operating room equipment, safety engineering, human factors, anesthesia machine

INTRODUCTION

Although formal didactic lectures have long been a common teaching method in medical education, retention of content following a traditional lecture is estimated to be 5%. Furthermore, attention span is estimated to wane after 15-20 minutes, far before the end of a one-hour lecture.[1] Winter et al. studied seventeen family medicine residents over a course of six months, testing for memory retention over a series of didactic lectures. They found that long term retention of the material did not differ between residents who attended compared to those who did not.[2] Clearly, there is a need to improve these sessions to increase attention and long-term retention of information.

Kolb theorized that learning is achieved through experience.[3] Experiential learning theory explores learning as a cycle of encountering new experiences that create a change in one's paradigm of the world. Kolb's cycle has four steps: 'concrete experience, reflective observation, abstract conceptualization and active experimentation.'[4] Using this framework, students are presented with a new concept and must reflect, rationalize, and act to test new conclusions.[3] Although this cycle may be an oversimplification ignoring the importance of contextual learning, this theoretical model serves as a starting point for changing passivity in medical education. In other words, while traditional lectures may present new material and one may reflect and

rationalize on it, they lack the active experimentation to help solidify conclusions into the student's mind.

Design thinking uses a similar process. In the IDEO model, the designer must understand the user experience, define the problem, generate solutions, and test those against the real world.[5] Beckman and Barry explore the relationship between Kolb's experiential learning theory and their own innovation model. Their four stages of observation, frameworks, imperatives, and solutions map directly onto Kolb's experiential learning theory. Learning is a cycle of observations (experience) to frameworks (reflection) to imperatives (conceptualization) to solutions (experimentation).[6]

In essence, the designer puts Kolb's experiential learning theory into action by testing their conclusions and incorporating their conclusions into the design. One might apply "design" to the classroom, where the teacher is the designer while the student, the user. The teacher must empathize with the student and identify learning opportunities. Then, they frame the problem by asking what the student does not understand and what barriers are in the way of achieving comprehension. Finally, The teacher comes up with potential solutions (curriculum) and tests them by delivering it to the students. In this case report, we explore a pilot course that puts the student into the designer role by using design thinking for a resident didactic session on OR Equipment and Safety.

MATERIALS AND METHODS

Five CA-1 anesthesiology residents in 2021 at the University of Vermont participated in a one-hour activity on The Practice of Anesthesiology: The Operating Room, Medical Gas, Environmental Factors and Electrical Safety. Before the activity, the faculty member assigned a chapter on OR Equipment and Safety. The session outline is as follows:

- Mechanics
    - Pressure Measurement of Gases, Liquids
    - Transducers, Regulators, Medical Gas Cylinders
    - Principles of Ultrasound: Obtaining an Image, Resolution, Depth, Frequency, Resonance
- Flow Velocity
    - Viscosity-Density, Laminar-Turbulent Flow
    - Flowmeters: Rotameter
- Alarms and Safety Features: Operating Room, Electrical, Anesthesia Machine, Ventilators, Capnometer, Oxygen, Hemodynamic Monitors
- Electrical; Fire and Explosion Hazards; Basic Electronics
    - Source of Ignition; Static
    - Prevention: Grounding, Isolation Transformers
    - Macro and Micro Current Hazards
    - Safety Regulations; National Fire Protection Association (NFPA) Standards
    - Risk Factors for Intraoperative Fire[7]

In previous years this session was delivered as a traditional lecture. For this session, the residents were given the following prototyping materials:

- Blue, green, yellow, and red string
- Blue, yellow, and green sticky pads
- Colored cardboard paper
- Permanent markers of a variety of colors and sizes
- Colorful pipe cleaners
- A cardboard box
- Glue
- Tape
- The furniture and wall space in the room

The residents were given ten minutes to brainstorm the requirements of a functional OR, followed by thirty minutes of active prototyping. This activity did not require IRB review and approval, as it did not meet the regulatory definition of research per the University of Vermont Research Protections Office.

RESULTS

General feedback from residents (60% response rate) was positive. They reported in a non-structured paragraph via email that the session increased their awareness of OR equipment that they would have otherwise disregarded and left them with an increased propensity for patient safety. They also described the session as engaging for an otherwise dry topic, with one resident reporting that “it was memorable and educational.”

DISCUSSION

This case report describes an educational activity that required residents to think critically about the necessary functions of anesthesia machines. To complete the task, the residents were challenged to defend inclusion of each component. The prototyping created a tangible experience to allow the residents to connect new knowledge to their pre-existing schemas, so they were more likely to recall the content in the future.[8] Altogether, using design thinking may help the residents retain critical information and understand the purpose of each item in the OR.

In a traditional lecture-based format, the instructor is the designer. Lost are the opportunities for learners to test their knowledge against experience, a key component of learning. In 2019, Panke discussed previous attempts at incorporating design activities in healthcare. Those include #ElsevierHacks, an international design competition that aimed to produce solutions to problems using the design method, and "Hacking Healthcare," a pilot interdisciplinary course at the University of Amsterdam which used the design process to learn about systemic healthcare issues.[8] Additionally, Suson et al. describe prototype learning activities in a high school chemistry class in the Philippines which found an association with high performance in the science topics addressed. That activity aimed to use prototyping to teach, as opposed to produce solutions.[9] When the student assumes the role of the designer, then that new script may allow them to engage in the experience required for learning.

For the OR Equipment and Safety session, the department identified a lecture that needed to be revamped. The design prototype version of the OR Equipment and Safety session serves as a pilot for delivery of engaging didactics. Informal feedback after the session was positive, demonstrating the residents were pleased with this delivery method. Limitations include a small

sample size and a non-quantitative assessment of efficacy. A meaningful assessment of success for this education method would gauge long-term retention of the material. To determine the outcomes of this case report, we will use prior and future ITE data from our program. We predict a 50% increase in the ITE scores for these topic areas within two years of implementation and continuation of this novel teaching method. Future educational efforts should ascertain the applicability of this learning format to other lectures in an effort to improve engagement and retention. Anesthesiology is well-suited to incorporation of design activities into didactic education due to its unique position as both a cerebral and procedural specialty.

CONCLUSION

We describe a CA-1 didactic session on OR safety in which a prototyping activity replaced a traditional lecture format as learning tool, the first of its kind described in the literature. General self-reported feedback was positive on both engagement and efficacy of the activity.

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