Teaching sterile skills in anesthesia
Cnossen, Fokeltje; Paul, Katja; Lettinga, Roelof; Wietasch, Johann

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Publication date:
2015

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):
Teaching sterile skills in anesthesia
Is providing context helpful for robust skill acquisition?

Fokie Cnossen¹, Katja Paul¹, Roelof Lettinga² & Götz Wietasch²
¹ Cognitive Modeling group, Institute of Artificial Intelligence and Cognitive Engineering, University of Groningen
² Anesthesiology, University Medical Centre Groningen
¹.cnossen@ rug.nl

EPIDURAL ANESTHESIA
- Pan relief method during childbirth and during and after operations
- As it is an invasive technique, it carries the risk of contamination
- Residents basically learn the procedure in the clinic
- Even after 4 years of training, residents still make sterility errors (Friedman et al, 2008)
- sterility is a complex concept
- sterility is not visible

PRESENT TRAINING IS NOT OPTIMAL
- Medical skills should be flexible and robust (Cnossen, 2015)
  - Flexible: applicable outside context in which it was learned
  - Robust: resistant to stress and workload
- Present training of complex procedures often focuses on the order of the steps of the procedure
  - This makes learning vulnerable
- steps may be forgotten and skipped
- steps may be performed in the wrong order
- In practice there is no fixed order of steps
  - different procedures have different steps, equipment, medication
  - not all steps have to be performed in a strict order
  - in practice, every supervisor has their own preferred order and method
- Focus on the steps in the procedure during learning
  - does not lead to flexibility in the skill
  - what if a step cannot be performed
  - does not lead to robustness of the skill
  - in stress situation memory errors can happen

DIFFERENT APPROACH: FOCUS ON THE CONTEXT
- Taatgen, Huss, Dickison & Anderson (2005) showed that in teaching flexible cognitive skills teaching materials should draw attention to
  - the pre-conditions of actions (knowing when)
  - the post-conditions of actions (knowing the effects of actions in the environment)
- They found that Boeing pilots were more flexible and the skill was more robust after learning with a focus on these environmental cues
- learners can then rely on environmental cues rather than keeping track of all the executed steps in their mind
- We applied this approach to training preparing and executing epidural anesthesia

METHOD
- 37 medical students participated in simulation study
- Skill preparation of epidural anesthesia
  - 14 steps
  - 10-15 minutes
- Procedure
  - Video instruction of procedure
  - Studying description of steps on paper
    - non-sterile actions written in red
    - sterile actions written in green
  - 15 minutes practice with materials and instruction sheets
  - Test: perform the procedure with an “non-constructive nurse”

Instructions
- List condition
  - 34 steps in chronological, strict order
- Context condition
  - steps arranged in sets
  - order within set was not important
  - photographs
  - pre-conditions of a set of actions (“before”)
  - post-condition (“after”)
  - description of the actions to be performed within the set

DISCUSSION
- Contrary to expectation the context condition did not result in robust skill
  - This stands in contrast to Taatgen et al’s study
  - Context condition even resulted in more sterility errors than the list condition
- Why?
  - Environmental cues
    - In epidural anesthesia procedure, there are also many environmental cues in list condition
      (eg syringe filled or empty?)
    - Boeing pilots used complicated system with low usability, so possibly profit more from context
  - Memory load
    - Context condition possibly imposed larger memory load on participants
    - The known advantages of the context method were at least partly offset by the disadvantages of this high memory load
- Sterility
  - Apparently, sterility errors are difficult to prevent, even though we explicitly noted which steps of the procedures were sterile or not
  - The participants in the experiment were probably unfamiliar with the concept of sterility
  - Sterility is a complex concept
    - It is not obvious for example that crossing a sterile workspace with (unsterile) bare underarms is not sterile

CONCLUSIONS & RECOMMENDATIONS
- Complex medical skills involve many steps and induce a high memory load to learn them
  - Providing context when teaching a procedure may therefore not necessarily lead to better skill acquisition than learning the steps
  - but the resulting skill may be more flexible and robust after context-learning
- Further research is needed to test whether it may be advantageous to first study the steps in a procedure until all steps are remembered before performing the skill
  - separating studying the declarative knowledge from training the procedural skill
  - we can then also test the flexibility and robustness of the skill
- Further research is needed to test whether teaching sterility concepts separately from the procedure itself is needed

MAIN RESULTS

REFERENCES