



Does Simulation Fidelity Affect Training? A Lesson from a Brief Review of Literature



charles river analytics

Pooyan Doozandeh

pooyan.doozandeh@gmail.com

Frank Ritter

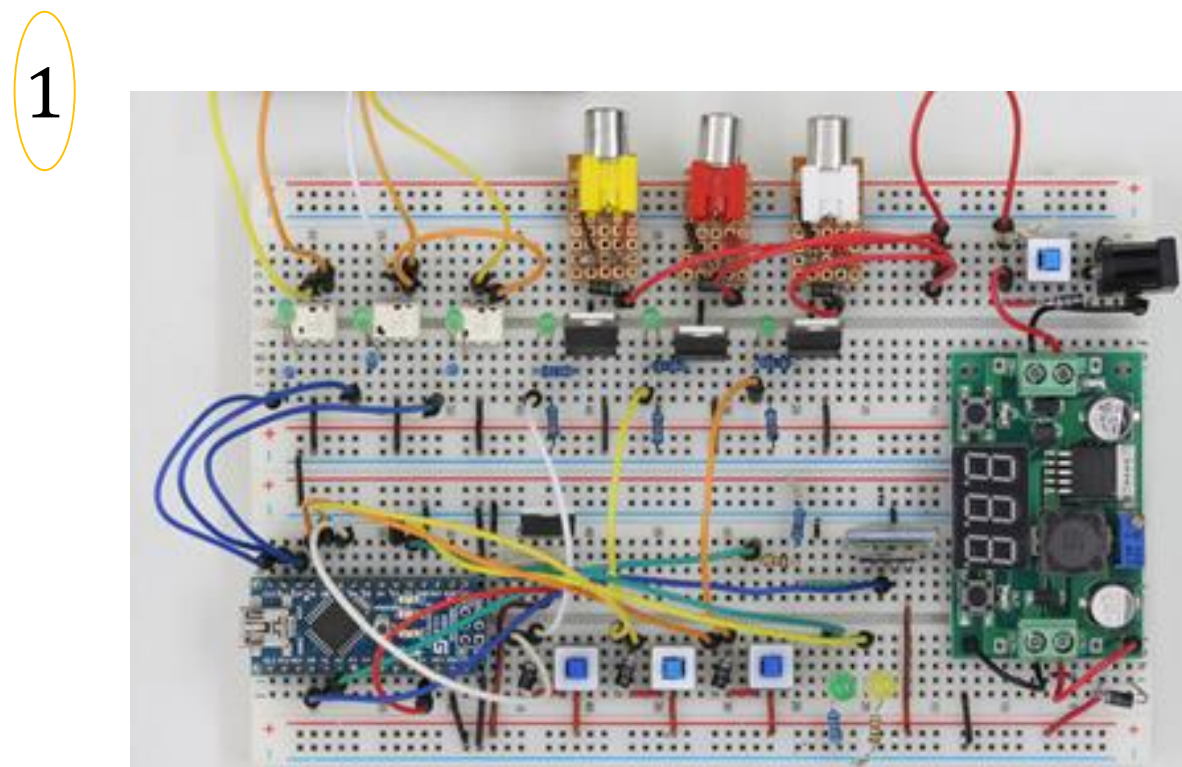
frank.ritter@psu.edu

College of Information Sciences and Technology, The Pennsylvania State University

Introduction

- In training programs, fidelity of simulation is the level of surface realism of training materials [1].

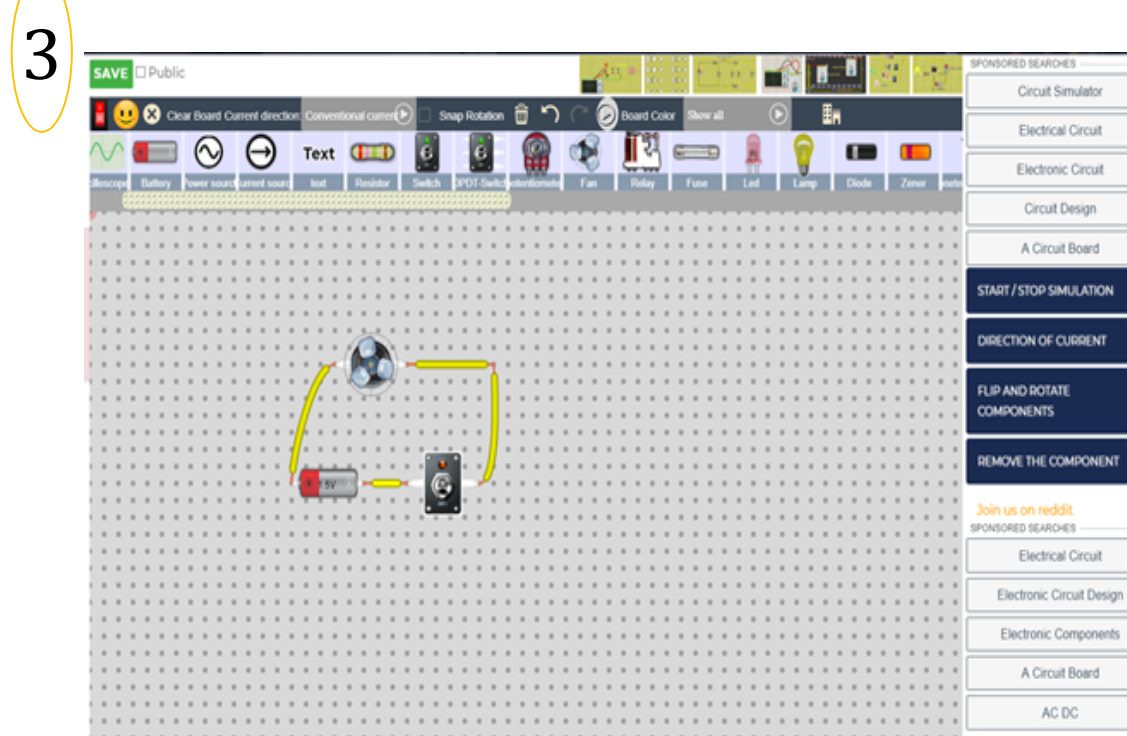
Example: Troubleshooting electronic circuits



High-fidelity (breadboard)



Mid-fidelity (SnapCircuit)

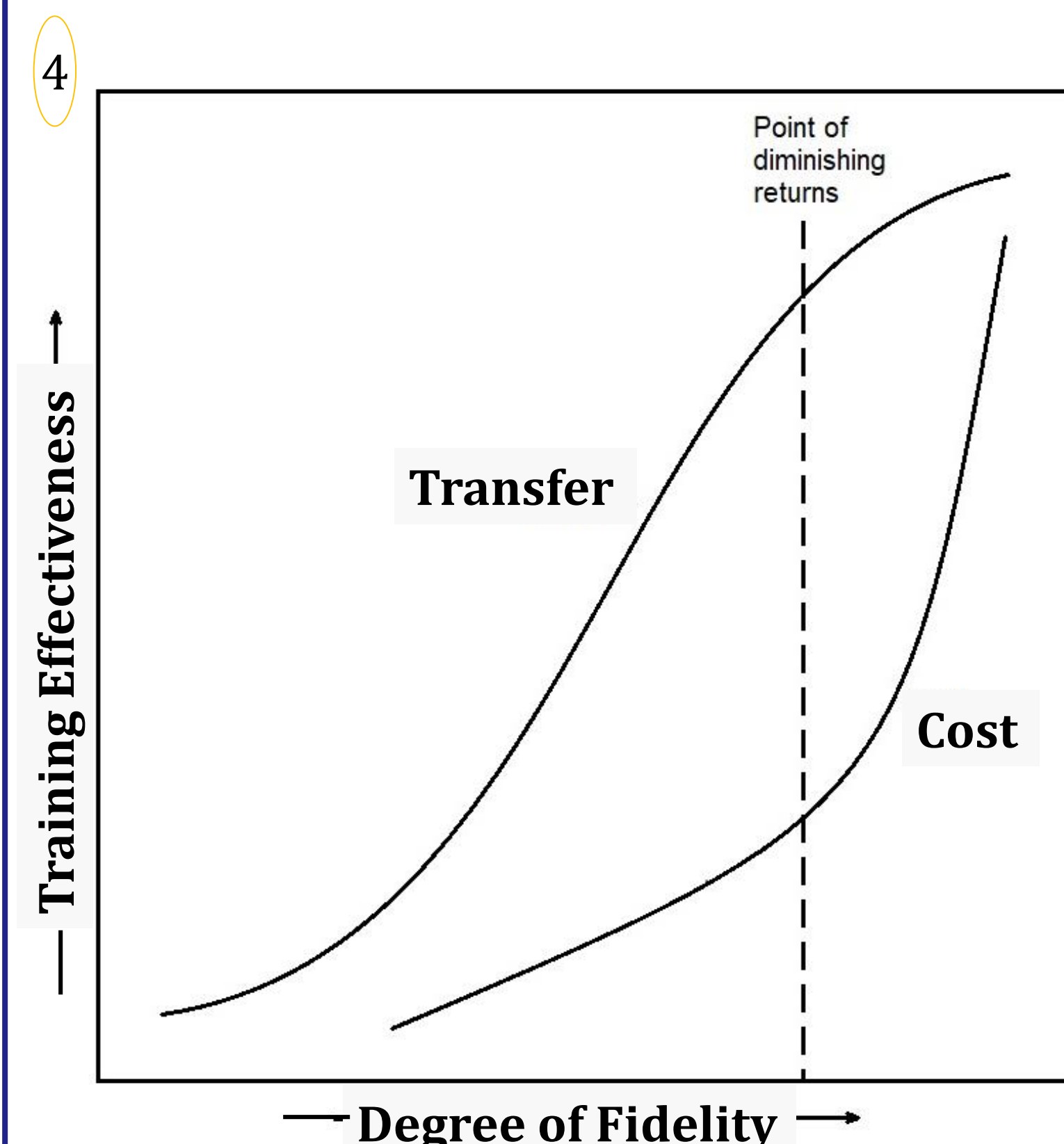


Low-fidelity (software)

- Traditional assumption: simulators with higher fidelity are more effective in training than those with lower fidelity [2, 3].
- Recent findings question this assumption. In many cases, low-fidelity systems were more effective in training than high-fidelity systems [4, 5].
- This has caused problems as designers do not know what level of fidelity is suitable for training systems [6].

Our goal is to review the literature to see the effect of fidelity on training in various domains.

Traditional assumption



Challenging findings



Lower fidelity resulted in equal or better training.

Review

We categorized major domains that use training systems:

1 Healthcare

In healthcare and medical training, although the belief in the traditional theory still strongly exists, recent studies has challenged the widespread trend towards high-fidelity simulation [6, 7].

2 Flight training

Despite the established practice of using expensive high-fidelity flight training systems [3], Dahlstrom et al. [8] showed that high-fidelity flight-training simulation does not necessarily lead to better performances in target environments.

3 Maintenance and troubleshooting

Rouse [9] showed that, unlike high-fidelity systems,

low-fidelity training simulators could train skills that could be transferred to a wide variety of tasks.

4 Other areas

Similar results were found in firefighting [10], route-learning [11], and some other areas.

Conclusion

- In many cases, low-fidelity systems are more effective in training than high-fidelity systems.
- So, fidelity is not a reliable construct in design.
- The remaining question is how to design training systems now?
- The future needs theories of design that focus on human elements of the training cycle (novices and experts) as a resource for designing training systems.

Note. A comprehensive review on the same topic is in preparation. If you are interested to see the incoming review, please write down your email address and name.

Acknowledgement. We thank members of the Applied Cognitive Science Lab in Penn State for their comments during the preparation of this poster. Sponsored by ONR N00014-18-C-7015.

References

- Hays, R. T., & Singer, M. J. (1989). *Simulation fidelity in training system design: Bridging the gap between reality and training*. New York, NY: Springer-Verlag.
- Miller, R. B. (1954). *Psychological considerations in the design of training equipment* (WADC Report No. 54-563, AD 71202). Springfield, OH: Carpenter Litho & Prtg. Co.
- Lee, A. T. (2005). *Flight Simulation: Virtual environments in aviation*. New York, NY: Routledge.
- Beaubien, J. M., & Baker, D. P. (2004). The use of simulation for training teamwork skills in health care: How low can you go? *Quality and Safety in Health Care*, 13(1), 51–56.
- Swezey, R. W., Perez, R. S., & Allen, J. A. (1991). Effects of instructional strategy and motion presentation conditions on the acquisition and transfer of electromechanical troubleshooting skill. *Human Factors*, 33(3), 309–323.
- Hamstra, S. J., Brydges, R., Hatala, R., Zendejas, B., & Cook, D. A. (2014). Reconsidering fidelity in simulation-based training. *Academic Medicine*, 89(3), 387–392.
- Durning, S. J., La Rochelle, J., Pangaro, L., Artino Jr, A. R., Boulet, J., van der Vleuten, C., & Schuwirth, L. (2012). Does the authenticity of preclinical teaching format affect subsequent clinical clerkship outcomes? A prospective randomized crossover trial. *Teaching and Learning in Medicine*, 24, 177–182.
- Dahlstrom, N., Dekker, S., van Winsen, R., & Nyce, J. (2009). Fidelity and validity of simulator training. *Theoretical Issues in Ergonomics Science*, 10(4), 305–314.
- Rouse, W. B. (1981). Experimental studies and mathematical models of human problem solving performance in fault diagnosis tasks. In J. Rasmussen & W. Rouse (Eds.), *Human detection and diagnosis of system failures* (pp. 199–216). New York, NY: Plenum.
- Toups, Z. O., Kerne, A., Hamilton, W. A., & Shahzad, N. (2011). Zero-fidelity simulation of fire emergency response: improving team coordination learning. In *proceedings of the SIGCHI Conference on Human Factors in Computing Systems, 2011*, 1959–1968.
- Çöltekin, A., Francelet, R., Richter, K-F., Thoresen, J., & Fabrikant, S. I. (2018). The effects of visual realism, spatial abilities, and competition on performance in map-based route learning in men. *Cartography and Geography Information Science*, 45(4), 339–353.

Conflict of Interest Statement. Frank Ritter is required by the Pennsylvania State University Conflict of Interest Program to include this paragraph [sic]: "I have financial interest with Charles River Analytics Inc., a company in which I provide consulting services and could potentially benefit from the results of this research. The interest has been reviewed and is being managed by the Pennsylvania State University in accordance with its individual Conflict of Interest policy, for the purpose of maintaining the objectivity of research at the Pennsylvania State University."