Design Practica as Authentic Assessments in First-Year Engineering Design Courses

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First-year design courses introduce tools such as creativity[1] and the design process[2] (the *what*).

1. D. Tolbert and S. R. Daly, "First-year engineering student perceptions of creative opportunities in design," *Int. J. Eng. Educ.*, vol. 29, no. 4, pp. 879– 890, 2013.
2. C. J. Atman and K. M. Bursic, "Teaching engineering design: Can reading a textbook make a difference?," *Res. Eng. Des.*, vol. 8, no. 4, pp. 240– 250, Dec. 1996.

First-year design courses can also demonstrate *how* those tools are enacted (e.g., ethics, teamwork)[1,2]

1. E. Cech, B. Rubineau, S. Silbey, and C. Seron, "Professional Role Confidence and Gendered Persistence in Engineering," *Am. Sociol. Rev.*, vol. 76, no. 5, pp. 641–666, Oct. 2011.
2. D. Kilgore, C. J. Atman, K. Yasuhara, T. J. Barker, and A. Morozov, "Considering Context: A Study of First-Year Engineering Students," *J. Eng. Educ.*, vol. 96, no. 4, pp. 321–334, Oct. 2007.

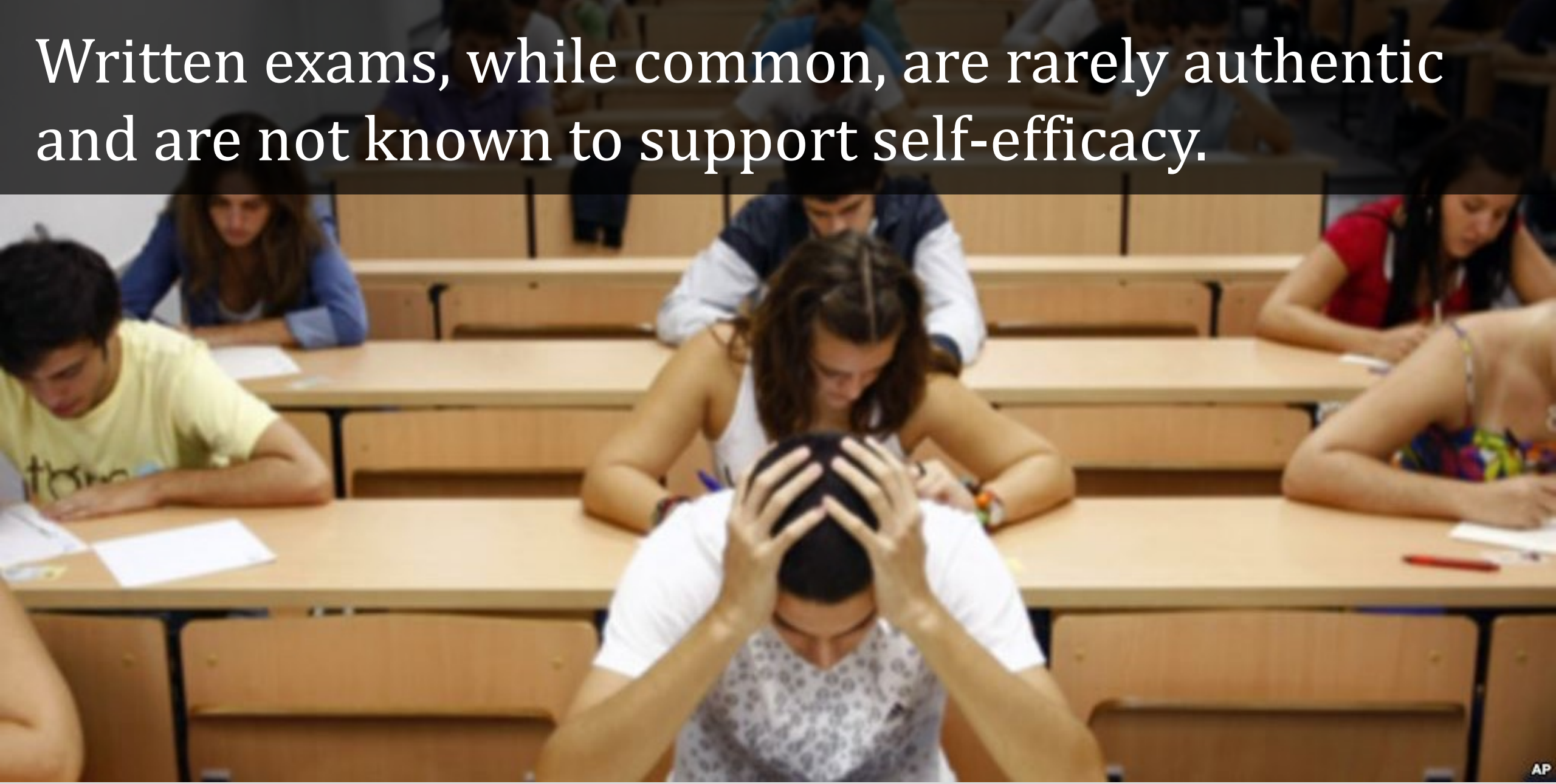
Self-efficacy is important to skill acquisition (the what and how)[1] as well as to retention in major.[2]

1. A. Bandura, “Self-efficacy: Toward a unifying theory of behavioral change.,” *Psychol. Rev.*, vol. 84, no. 2, pp. 191–215, 1977.
2. DeWitz, S. Joseph & Woolsey, M. Lynn & Walsh, W. Bruce. "College Student Retention: An Exploration of the Relationship Between Self-Efficacy Beliefs and Purpose in Life Among College Students." *Journal of College Student Development*, vol. 50 no. 1, 2009, pp. 19-34.

Authentic tasks can also aid skill acquisition and longterm learning.[1]

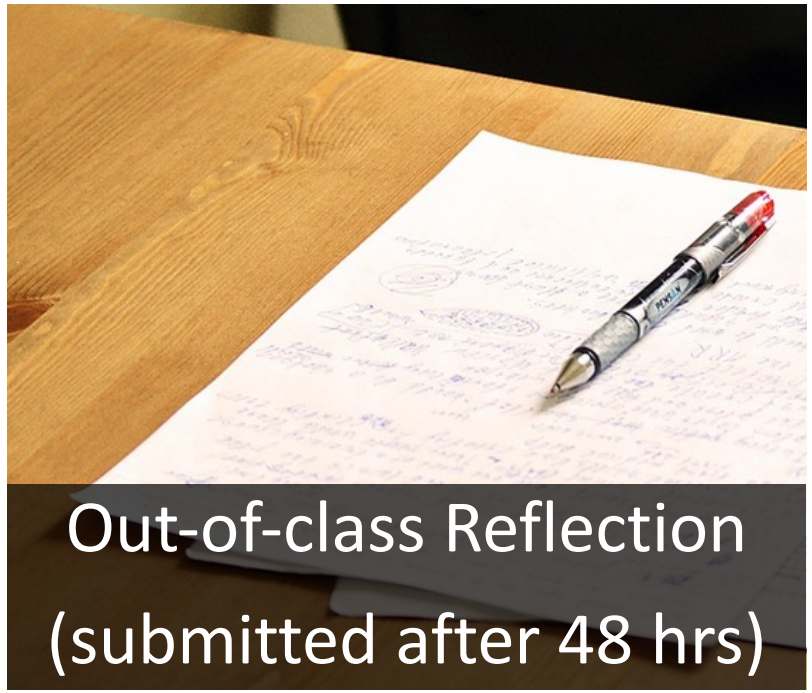
1. Strobel, Johannes, et al. "The role of authenticity in design-based learning environments: The case of engineering education." *Computers & Education* 64 (2013): 143-152.

Written exams, while common, are rarely authentic and are not known to support self-efficacy.



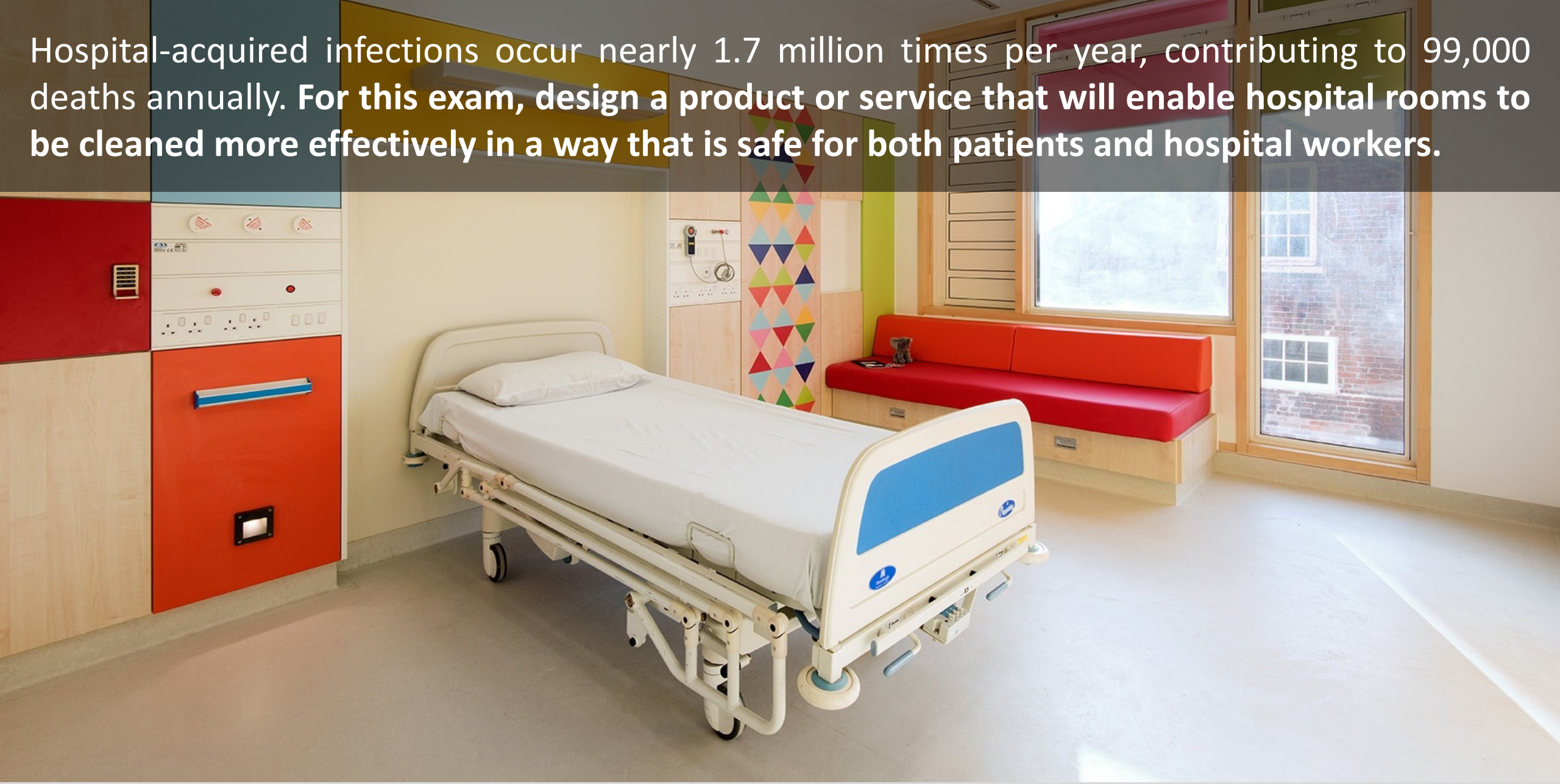
What alternative assessments might better support first-year objectives by encouraging self-efficacy?

We propose *design practica* as an assessment type that aligns with the objectives for the course.



Cape Town, a coastal city in South Africa, is running out of water. They estimate that by July 2018 there will be no more fresh water in their reservoirs. **For this exam, design a product or service that will aid in water conservation efforts, helping residents of Cape Town to extend their available water as long as possible.**

Hospital-acquired infections occur nearly 1.7 million times per year, contributing to 99,000 deaths annually. **For this exam, design a product or service that will enable hospital rooms to be cleaned more effectively in a way that is safe for both patients and hospital workers.**



This assessment was evaluated across two sections of a first-year engineering design course.

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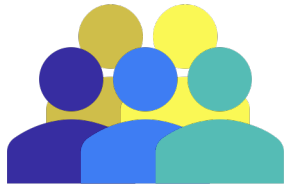
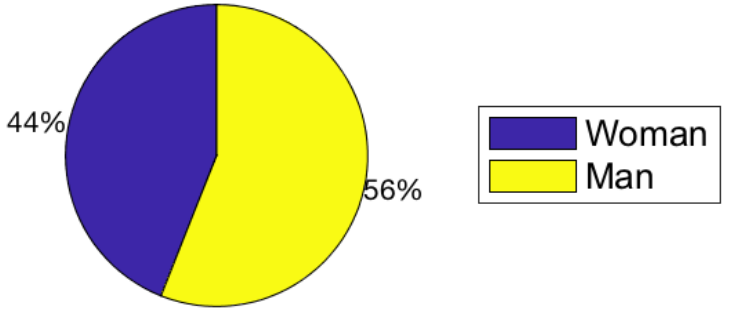
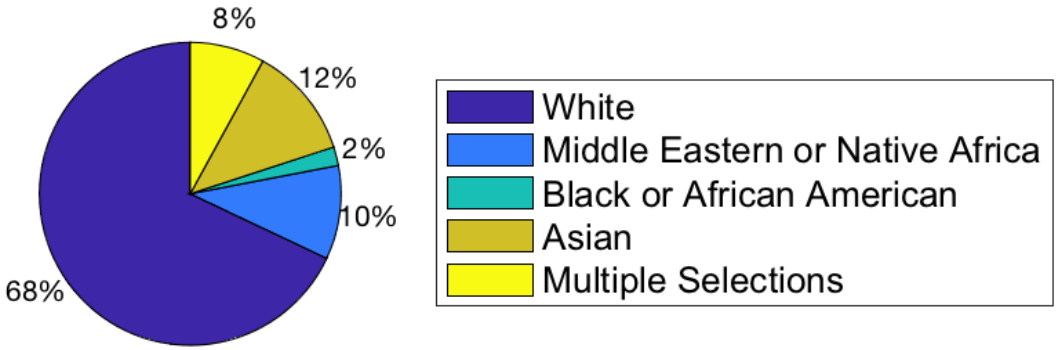
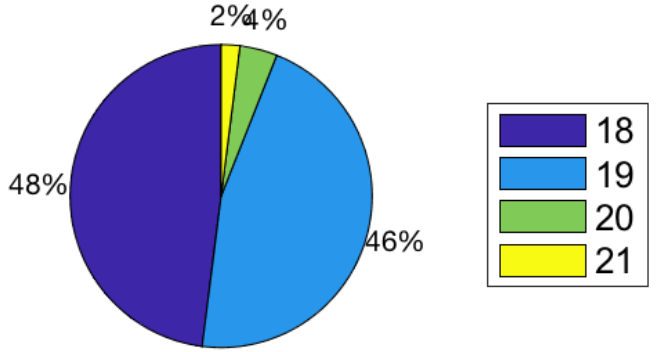
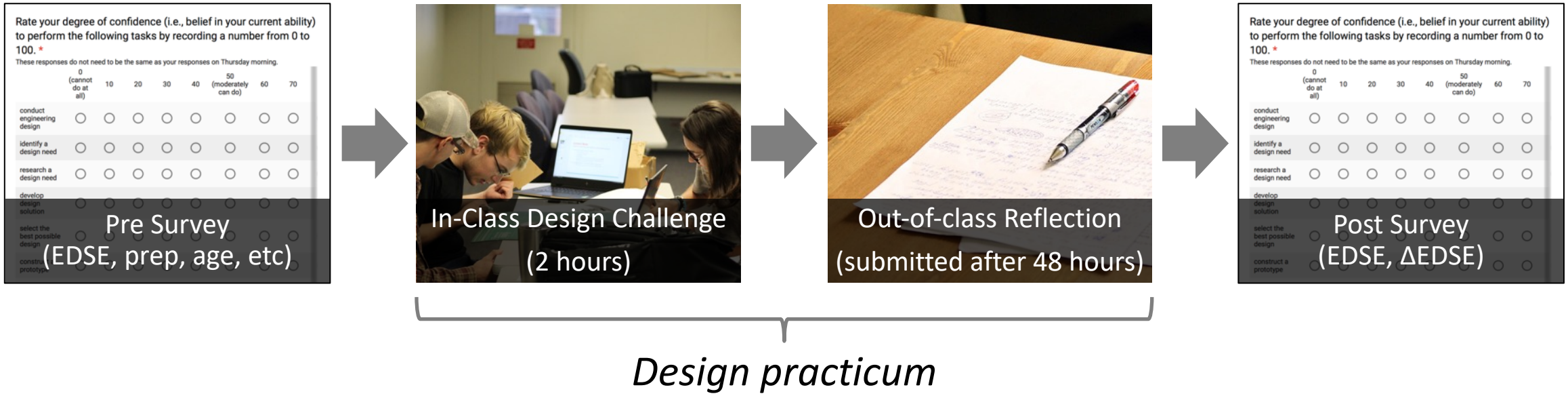






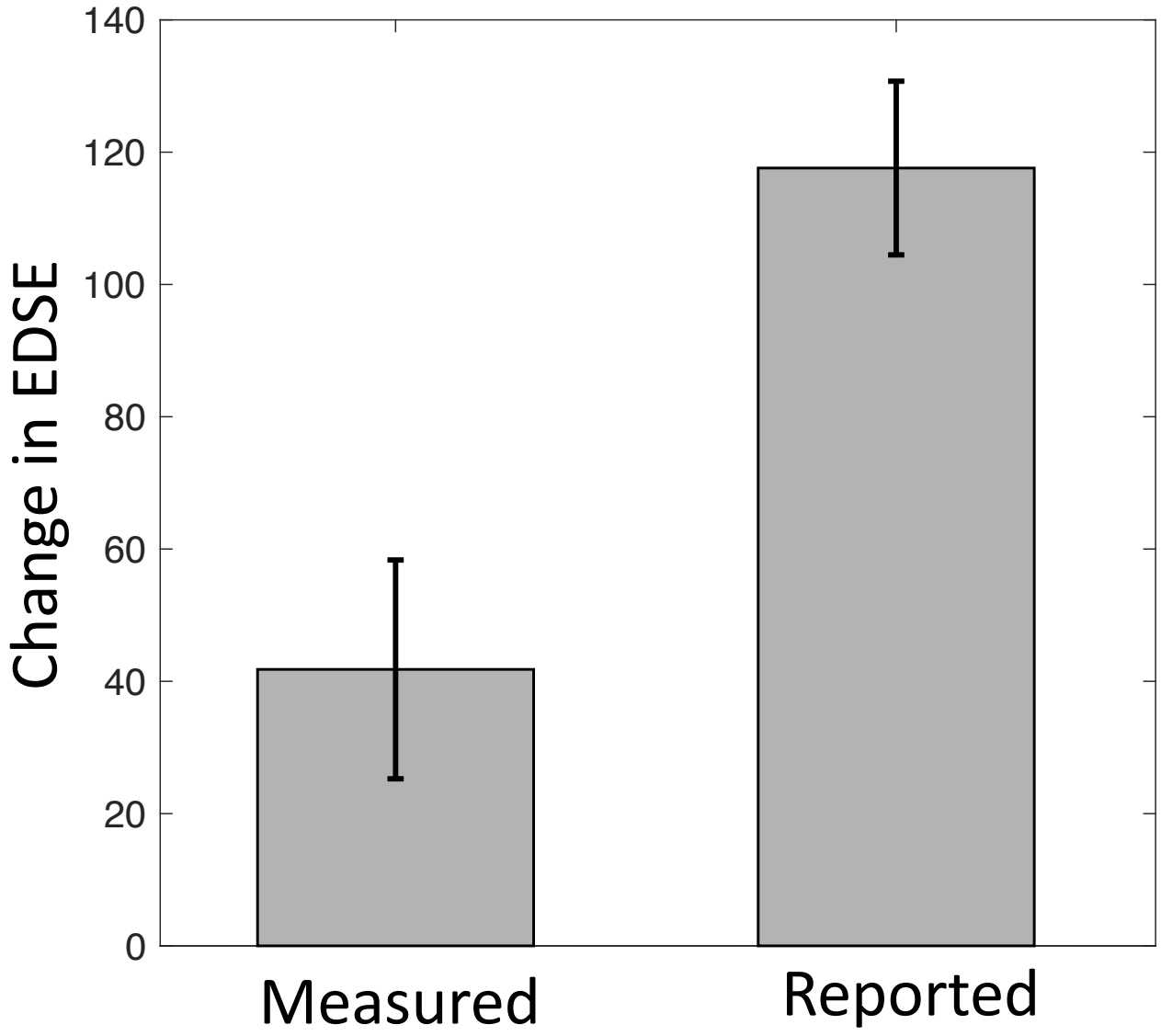


A pre- and post-survey were used to collect engineering design self-efficacy[1] (EDSE) and other information.



1. A. R. Carberry, H.-S. Lee, and M. W. Ohland, "Measuring Engineering Design Self- Efficacy," *J. Eng. Educ.*, vol. 99, no. 1, pp. 71–79, Jan. 2010.

Self-efficacy increases both as measured (post-pre) and as directly reported by students.



Predictors for post-assessment EDSE included preparation, gender, and pre-assessment EDSE.

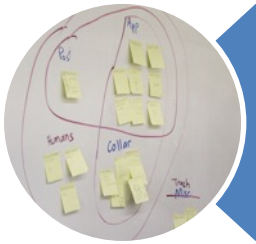
Model Term	Estimate	S.E.	t	Sig.
Intercept	153.39	36.51	4.20	< 0.001
Gender (woman)	31.74	14.94	2.12	0.039
Preparation (true)	-62.39	15.08	-4.14	< 0.001
Pre-assessment self-efficacy	0.86	0.05	16.14	< 0.001

Predictors for reported change in EDSE included age, gender, and preparation.

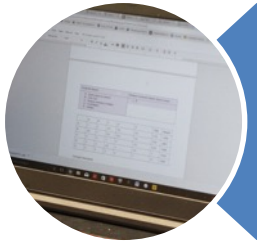
Model Term	Estimate	S.E.	t	Sig.
Intercept	871.21	302.57	2.88	0.006
Age	-40.21	16.06	-2.50	0.016
Gender (woman)	46.81	21.59	2.17	0.036
Preparation (true)	-58.96	21.56	-2.74	0.009
Race/Ethnicity (minority)	32.67	23.66	1.3809	0.175

To summarize:

Design practica increase engineering design self-efficacy, both as measured and as reported.

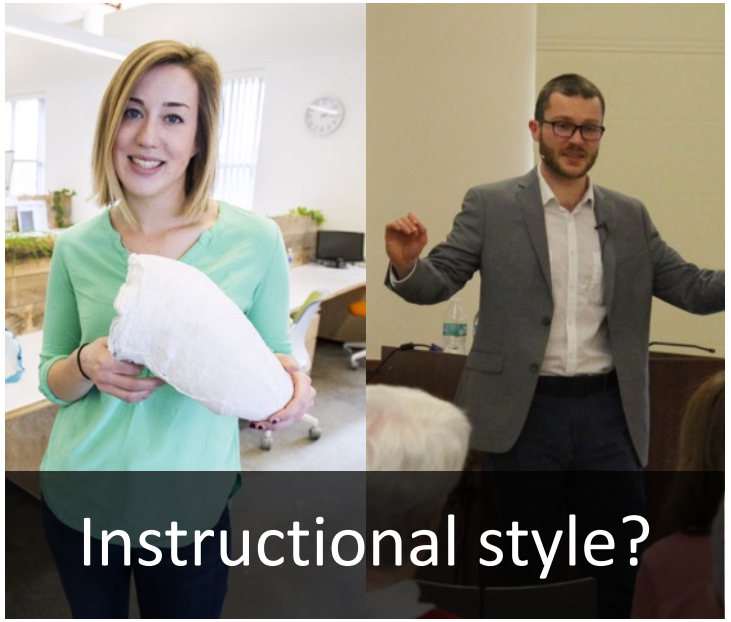


Post-assessment EDSE is predicted by gender, preparation and pre-assessment EDSE.



Reported change in EDSE is predicted by age, gender, and preparation (and possibly race/ethnicity).

We have more questions!



Thank you! Questions?

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