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


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

Authentic tasks can also aid skill acquisition and long-term learning.¹

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.

In-Class Design Challenge (2 hours)

Out-of-class Reflection (submitted after 48 hrs)
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.
A pre- and post-survey were used to collect engineering design self-efficacy\(^1\) (EDSE) and other information.

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.

<table>
<thead>
<tr>
<th>Model Term</th>
<th>Estimate</th>
<th>S.E.</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>153.39</td>
<td>36.51</td>
<td>4.20</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Gender (woman)</td>
<td>31.74</td>
<td>14.94</td>
<td>2.12</td>
<td>0.039</td>
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<tr>
<td>Preparation (true)</td>
<td>-62.39</td>
<td>15.08</td>
<td>-4.14</td>
<td>&lt; 0.001</td>
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<tr>
<td>Pre-assessment self-efficacy</td>
<td>0.86</td>
<td>0.05</td>
<td>16.14</td>
<td>&lt; 0.001</td>
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</tbody>
</table>
Predictors for reported change in EDSE included age, gender, and preparation.

<table>
<thead>
<tr>
<th>Model Term</th>
<th>Estimate</th>
<th>S.E.</th>
<th>t</th>
<th>Sig.</th>
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</thead>
<tbody>
<tr>
<td>Intercept</td>
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<td>2.88</td>
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<td>Race/Ethnicity (minority)</td>
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<td>23.66</td>
<td>1.3809</td>
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</table>
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!

Design or reflection?

Instructional style?

Diversity implications?
Thank you! Questions?

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