

# OER Mechanics Project

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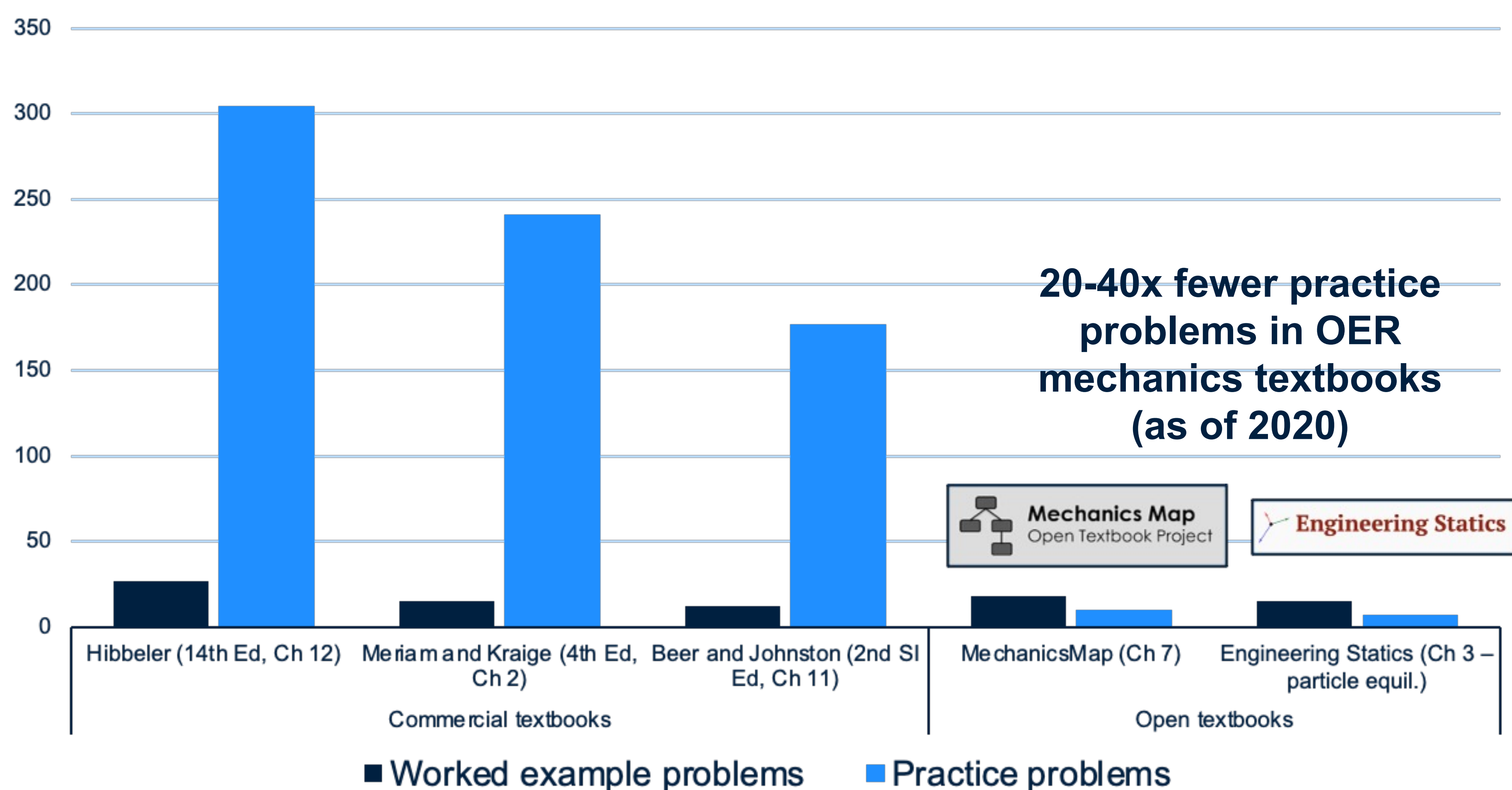
## Why Mechanics?

Mechanics is a **core subject in multiple engineering disciplines as well as in physics**.

Mechanics is taken by every first-year engineering student in BC, and every second-year Mechanical Engineering student at UBCV (~130 per year). The current required mechanics textbook (which covers both first- and second-year) costs \$200.

Additionally, mechanics is a topic that **has not changed substantially in a century**, and **almost all engineering programs across North America use one of a handful of commercial mechanics textbooks**, meaning content differs little between institutions<sup>1</sup>. One good OER text could have high impact.

Finally, mechanics was the **only first-year engineering topic without a viable OER textbook** option as of 2020, limiting the ability to make first-year engineering a Zero Textbook Cost (ZTC) program in BC<sup>2</sup>. While existing open textbooks had good theoretical content, **what was missing was practice problems** (Fig.1).



## Three Main Project Outputs

As part of this project, we created/converted/expanded three outputs:

### 1. Mechanics Map open online textbook (1<sup>st</sup> & 2<sup>nd</sup> yr)<sup>3</sup>

- Expanded to cover dynamics (particle and planar rigid body) and introductory vibrations (starting in 2019)
- Expanded worked problems (video solutions)
- Adopted by Penn State (1<sup>st</sup> yr), Douglas College (1<sup>st</sup> yr), UBC (2<sup>nd</sup> yr)**

Overall Mechanics Map usage (June 5, 2022 to June 6, 2023):

- Over a one year period, 137,000 users accessed the site an average of 2,300 times per day.
- ~25% of traffic comes directly (e.g. from LMS link, rather than searches).
- Canada is 4th country by traffic, with ~8,000 users.

### 2. ~2,000 WeBWorK problems (1<sup>st</sup> & 2<sup>nd</sup> yr)<sup>4</sup>

- Can be used in WeBWorK, converted to another system, or used to create static problems (Fig. 2)
- Can replace paid online homework systems (free v \$78/student/course<sup>5</sup>)
- Adopted by Douglas College (1<sup>st</sup> year), UVic (1<sup>st</sup> year), and UBC (2<sup>nd</sup> year) (with USask (1<sup>st</sup> year) using same problems on a different system)**

### 3. ~1,500 professional-quality mechanics problem images (1<sup>st</sup> & 2<sup>nd</sup> yr)<sup>6</sup>

- Openly licensed (Creative Commons) – anyone can use/modify (Fig. 2)
- Original Adobe illustrator images (plus style guide) available to modify
- Used regularly by adopters to create new problems (e.g. for exams)**

Figure 1: Comparison of problem numbers in commercial and open mechanics textbooks

Based on one representative chapter, as of 2020.

Figure 2: Sample WeBWorK mechanics problem, including image

Features such as individual random variables, multiple answer boxes.

You ask your little cousin to move a 1.5 kg box up a hill with a coefficient of kinetic friction  $\mu_k = 0.25$ . Rather than carrying the box, he overthinks things and drags the box up the hill with a rope. Determine the work done by your little cousin and the work done by friction if he applies a constant force  $F = 17 \text{ N}$  and the drags the box up the hill  $d = 2.5 \text{ m}$  with an incline of  $45^\circ$ . How long will it take him to do so?

$U_F = \text{[ ]} \text{ J}$   
 $U_{FF} = \text{[ ]} \text{ J}$   
 $t = \text{[ ]} \text{ s}$

## [What is WeBWorK?]

- Open source online homework platform with Open Problem Library (OPL)
- Ideal for numerical or symbolic problems
- Can provide hints, solutions
- Auto-graded, instant feedback
- Free to students

## References

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