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UNIVERSITY OF CALGARY

Department of Geomatics Engineering

# Course design and development in hydrographic surveying

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Virtual FIG 2021 Meeting

# University of Calgary

- Located in Calgary, Alberta (east of the Rocky Mountains)
- Transitioning from oil & gas to high tech industry

# Department of Geomatics Engineering

- One of the few geomatics engineering departments in Canada
- The geomatics engineering degree opens the doors for two professional designations:
  - Licensed land surveyor (e.g., CLS, ALS)
  - Professional engineer (P.Eng.)

# Accreditation requirements

- Canadian Engineering Accreditation Board (CEAB)
  - Holistic approach based on accreditation units and graduate attributes

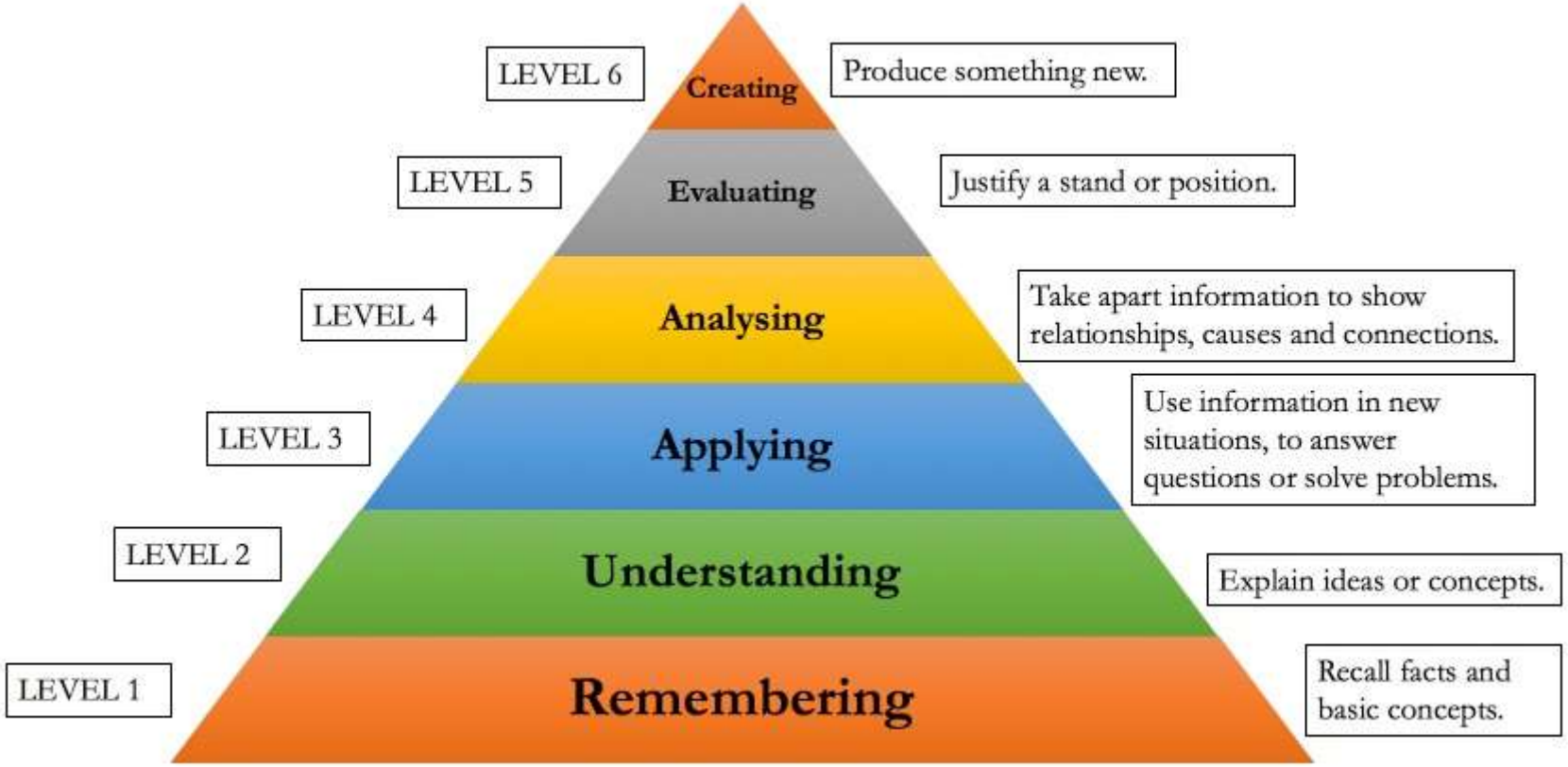
engineerscanada
ingénieurscanada

- Canadian Board of Examiners for Professional Surveyors (CBEPS)
  - Transition from prescribed course topics to learning outcomes

CBEPS
CCEAG

# Theoretical framework

- Bloom's taxonomy
- Alignment between learning outcomes, teaching & learning activities, and assessment



# Theory course on hydrographic surveying

- Course name and number: ENGO 545 – Hydrographic surveying (offered in fall semester, Sept to Dec)
- Fourth year technical elective in the geomatics engineering degree program
- Mandatory course for the cadastral concentration
- Challenge: extensive content with limited contact hours

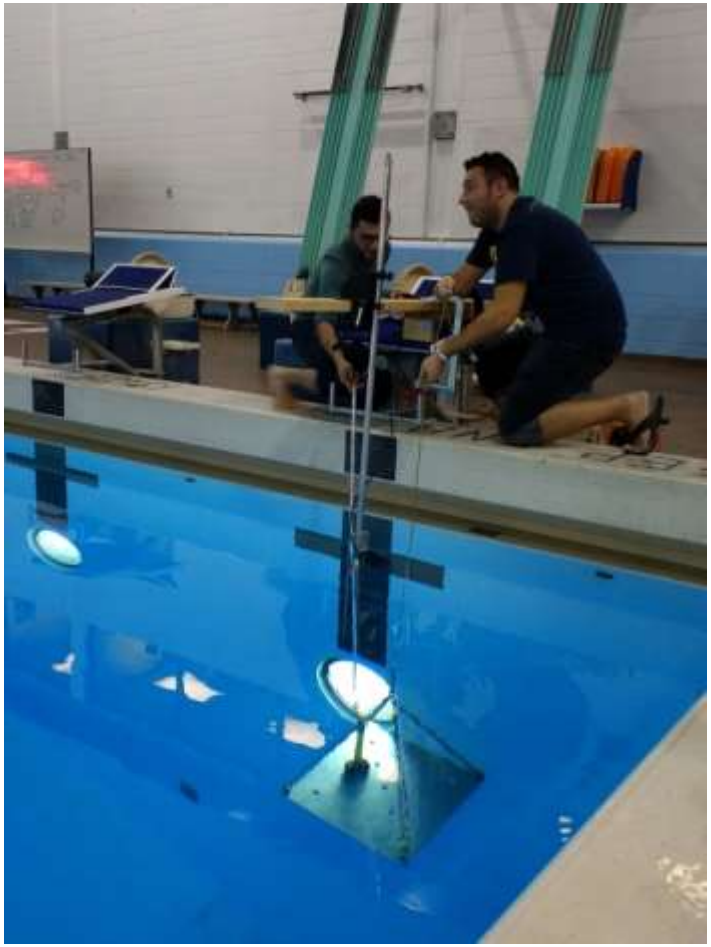
US Army Corps of Engineers

# Course design

- Selected course topics
  - Underwater acoustics, tides, water levels, and positioning
  - Sounding methods: single beam echo sounding (SBES), side scan sonar (SSS), multi-beam echo sounding (MBES)
  - Hydrographic survey design and specifications
- Selected learning outcomes
  - Recognise, interpret, and adapt international standards for hydrographic surveying for the safety of marine navigation
  - Design SBES and MBES surveys to meet international standards and specifications
  - Perform echo sounder calibration in order to mitigate system errors

# Course design (cont'd)

- Selected teaching & learning exercises
  - Individual and group in-class exercises
  - Programming and software labs
  - Plate check calibration
- Assessment
  - Prior to COVID: exam heavy
  - During COVID: more frequent lower impact homework



# Hydrographic surveying field exercise

- Course name and number: ENGO 501 – Field Surveys (offered in summer term, Aug to Sept)
- Fourth year core course in the geomatics engineering degree program
- Hydrographic surveying is one of several full day exercises: mapping a lake bed and performing a plate check calibration

# Plate check implementation: platform

**Fishing boat**

**Two-canoe catamaran**

The two-canoe catamaran is the preferred option as long as the canoes are compatible with the aluminum frame

# Plate check implementation: docking the HyDrone

**Ropes**

**Custom contraption**

The custom contraption is designed to keep the HyDrone from moving and also not to interfere with its draft

# Plate check implementation: suspension mechanism

**Manual**

**Winch**

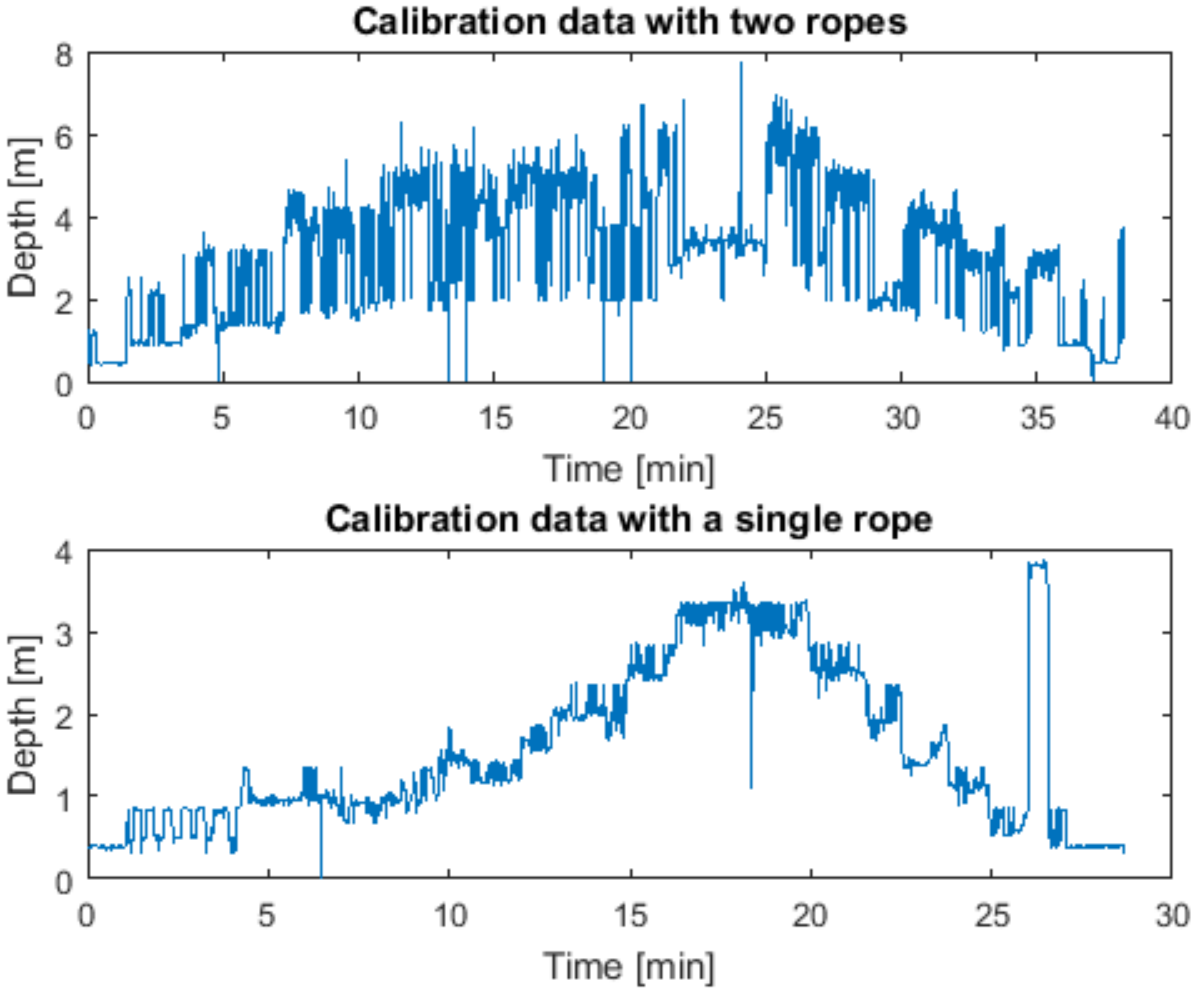

The custom-made gear reduction winch system with a spool helps improve the precision of the measurements

# Plate check implementation: points of contact

## Single rope


## Two ropes

# Plate check implementation: points of contact (cont'd)




Counterintuitively, the single rope setup performs better than the one with two ropes (at least with this particular SBES)

# Summary

- Described the geomatics engineering program at the University of Calgary
- Discussed applying Bloom's taxonomy when defining learning outcomes
- Explained the recent (re-)design of a theory course in hydrographic surveying
- Showed experiments related to performing a rigorous plate check calibration for a hydrographic surveying field exercise

# Future work

- Theory course
  - Add more in-class exercises
  - Overhaul the lab exercises
- Field exercise
  - Test more canoes
  - Try a rope compatible with a commercially available winch
  - Use a different type of SBES
  - Poll the students about their learning experience

# Acknowledgements


- Program for Undergraduate Research Experience (PURE) at Taylor Institute for Teaching and Learning



# Time for questions

?

# Theoretical framework

Extra slides

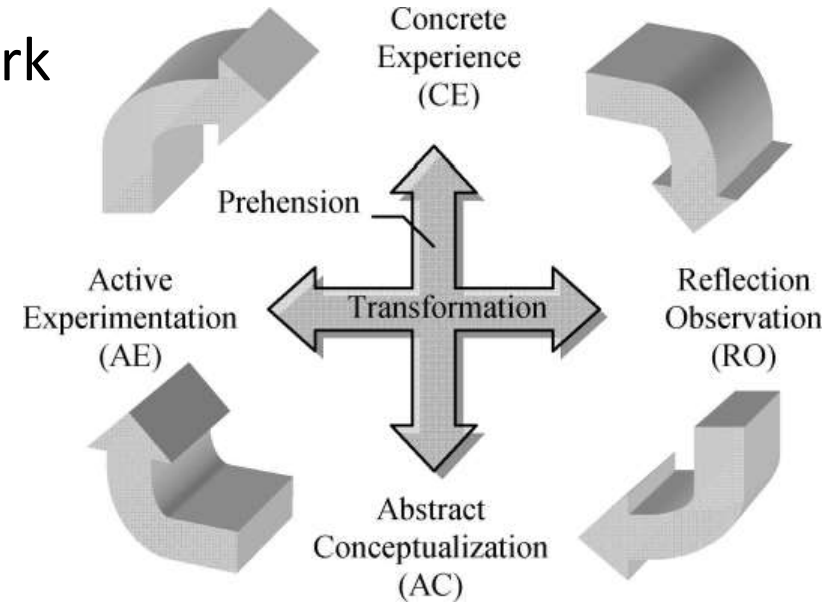
# Course design

- Learning outcomes
  - Lesson, module, or course level
- Teaching & learning activities
  - Contact hours, type of delivery, focus on student learning
- Assessments
  - Homework, exams, etc.
- Graduate attributes
  - Program level learning outcomes

- Alignment!

# Theoretical framework: teaching & learning activities

- Active learning
  - Review questions
  - Team-based learning (TBL)
  - Minute papers
- Experiential learning
  - Laboratory exercises / field work
  - Project-based learning
  - Survey camp
  - Co-op / internships



# Theoretical framework: assessments

- Distributed / spaced practice

# Accreditation: CEAB

- Accreditation units
  - mathematics, natural sciences, engineering science, engineering design, complementary studies, and other unspecified content
- Graduate attributes (introduced, developed, or applied)

1) Knowledge base for engineering
2) Problem analysis
3) Investigation
4) Design
5) Use of engineering tools
6) Individual and team work
7) Communication skills
8) Professionalism
9) Impact of engineering on society and the environment
10) Ethics and equity
11) Economics and project management, and
12) Life-long learning

# Accreditation: CBEPS

- Prescribed content topics, sub-topics, and ”learning outcomes” for 12 core:
  - C1 Mathematics
  - C2 Least Squares
  - C3 Advanced Surveying
  - C4 Coodinate Systems and Map Projections
  - C5 Geospatial Information Systems
  - C6 Geodetic Positioning
  - C7 Remote Sensing and Photogrammetry
  - C8 Cadastral Studies
  - C9 Survey Law
  - C10 Land Use Planning and Economics of Land Development
  - C11 Business Practices and the Profession, and
  - C12 Hydrographic Surveying

# Accreditation: CBEPS

- … and five elective subjects:
  - E1 Spatial Databases and Land Information Systems
  - E2 Advanced Hydrographic Surveying
  - E3 Environmental Management
  - E4 Advanced Remote Sensing, and
  - E5 Advanced Photogrammetry

- Note: for C12 the approximate distribution of ”learning outcomes” among the Bloom’s taxonomy categories is:
  - 50% in remembering
  - 15% in comprehending
  - 8.5% in applying
  - 14% in analyzing
  - 11.5% in evaluating, and
  - ~1% in creating