

## **Enhancing student learning of the fundamentals of surveying with the help of the ICAP framework**

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Fundamentals of Surveying is a second-year course in the Department of Geomatics Engineering at the University of Calgary. Class time consists of three fifty-minute lectures and a three-hour lab period in 12.5 weeks of the winter academic term. Teaching in this course has followed a very traditional approach of lecturing, tutorials and weekly group labs and individual calculation assignments. This is the first surveying course in the geomatics engineering degree that develops psychomotor skills in addition to cognitive skills. Therefore, it has been recently re-designed to include more active, constructive and interactive learning experiences in the classroom drawing ideas and inspiration from the ICAP (interactive-constructive-active-passive) framework. The classroom activities include equipment demonstrations, calculation exercises, problem solving, outlining main steps of field procedures, talks by industry and alumni, debriefing field experiences and summarising outcomes of the practical and calculation assignments.

The main objective has been to enrich student learning in the surveying classroom by achieving a reasonable balance of the four levels of learning. The re-design of teaching and learning has started with dividing each course unit into lessons. A lesson is a series of connected classroom activities with few simple and measurable learning goals. Then, the activities have been linked to the four types of learning. To study the student behavioral and cognitive engagement in the classroom, a detailed observation protocol has been designed, where the class activities are mapped with a 2-minute frequency. In addition, the students are assigned simple self-reflection exercises as a form of constructive learning at the end of each lesson as well as an end-of-unit survey in order to obtain the students' perspective of the learning process.