Learning tasks in EOAS

QES learning tasks data

Curriculum review is primarily about determining whether students are gaining the knowledge, skills and attitudes they need after graduating. Therefore, we are interested in characterizing the learning tasks and experiences encountered by students across their suite of courses. In any degree program, some discipline specific capabilities will be learned in specialized courses. At the same time, developing expertise requires use and reuse of skills and knowledge, so students will benefit from experiencing some repetition in course sequences. The survey data discussed below were obtained to learn about the types of learning tasks students encounter, focusing mainly on tactics used to develop the more generic types of skills rather on specialized or discipline-specific capabilities.

The Survey

Insights about what students currently do to learn, and what resources they use, were obtained from 51 EOSC, ATSC and ENVR courses based using a survey prepared with the support of K. Rawes at UBC's Career Services, and deployed in the 2021/22 school year using UBC's Qualtrics survey system used (link to a PDF of the survey).

Instructors of EOAS courses were asked to respond to the questionnaire by considering only one course for all questions. The table here summarizes response rates. QES (quantitative Earth science) courses highlighted in red italics varied from 63% to 100% of QES courses by discipline. Fewer biological oceanography and first year courses (1xx) were described, however these courses are not considered "quantitative" for the purposes of the QuEST project.

Type	No. of courses	Data from …	prop'n
eng	7	7	100%
hydro	***4***	***4***	***100%***
geol	15	13	**87%**
envr	7	5	**71%**
pocgy	***6***	***4***	***67%***
geop	***9***	***6***	***67%***
atsc	***8***	***5***	***63%***
1xx	6 (1 QES)	3 (1)	**57%**
bocgy	5	2	**40%**
Total	**61**	**46**	**75%**
QES -->	***28***	***20***	***71%***

Respondents were first asked to specify the course and their name because some courses have more than one instructor. Anonymity is not possible since it is well known who teaches what, however no names appear in results or analysis.

Results

Results from the first two questions are presented first for all 51 courses returning data and second for the 18 quantitative courses. Two of these 18 are 2nd year courses and 16 are for 3rd or 4th year students (courses are listed in the appendix).

Qn 1: How often do students work on the following 17 types of tasks?

From a curricular point of view, some important skills can be practiced in several, if not all, courses. For example, writing, presenting or reading within the discipline could be employed in most of a curriculum's courses. Also, many pedagogic practices such as in-class work in groups, frequent use of low-stakes quizzing, and others, are recognized as effective best practices, and any course could consider adding some of these methods to enhance students' learning outcomes. In contrast, some tactics may be more discipline-specific; practice problem sets for example are appropriate in most quantitative courses but may be less relevant in more qualitative or descriptive subjects. These survey questions focused on the more generally applicable learning and teaching tactics or practices.

Figure 1a: all 51 responding courses

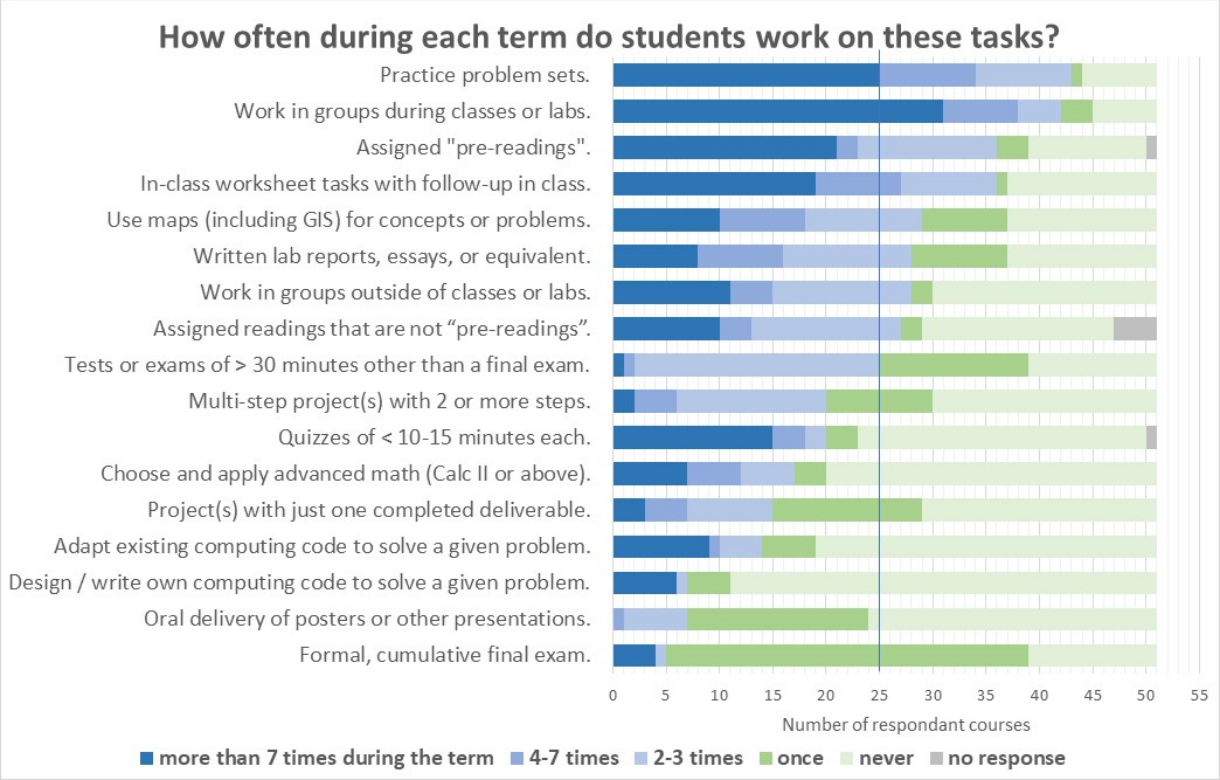
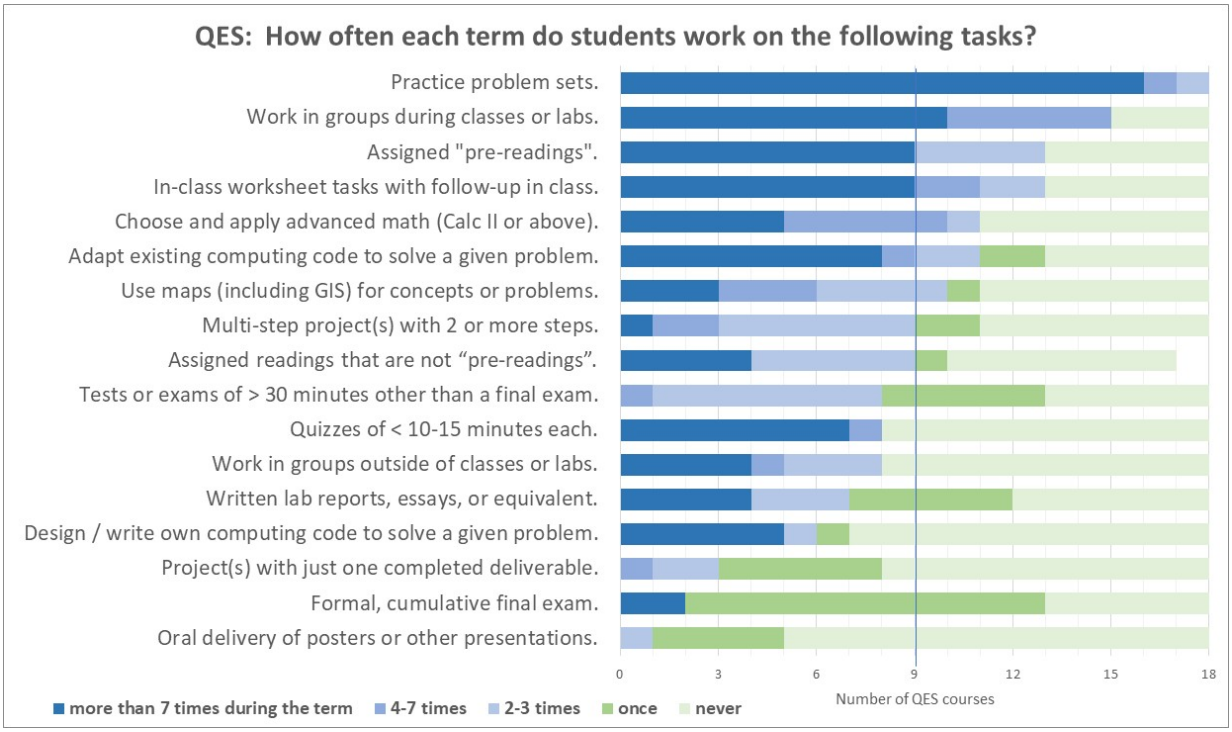


Figure 1b: 18 QES courses only.



Observations from 18 QES courses; question 1, Figure1b above.

- Not surprising
    - Practice in the form of problem sets is used in all 18 QES courses.
    - Students are expected to adapt existing code in 10 courses, and to design code in 7. Atmospheric science courses have the highest expectations regarding programming.
    - Longer in-class tests are used in 13 courses. These are good practice for final exams.
- Surprising
    - Pre-readings are assigned in 13 courses while "other" readings are given in only 10.
    - Only 11 of 18 courses expect students to choose and apply moderate or advanced calculus.
    - Short quizzes are used either 7 or more times in the term, or not at all.
    - Ten courses do not require students to work together outside of the classroom.
- Good to see
    - In-class group work is used "often" in 15 courses, but "often" for homework in only 8.
    - In-class worksheet activities are used in 13 of 18 courses.
    - Maps or GIS are used in 11 courses.
    - Written products are generated in 12, and projects in 8 courses.
- Recommendations
    - Making effective use of quantitative and Earth science readings takes practice. Increased use of readings would enhance lifelong learning skills and habits.
    - Frequent short quizzes help students keep current and regularly informs instructors and students about progress.
    - Students need more than one written assignment so they can benefit from feedback. Having only a single written assignment does little to support student improvement.
    - Consider adding projects &/or oral delivery of products in courses not already using them.

Qn 2: What course information is provided explicitly to students?

Options were inspired by, or borrowing from, the teaching practices inventory (TPI).

Figure 2a: all 51 responding courses

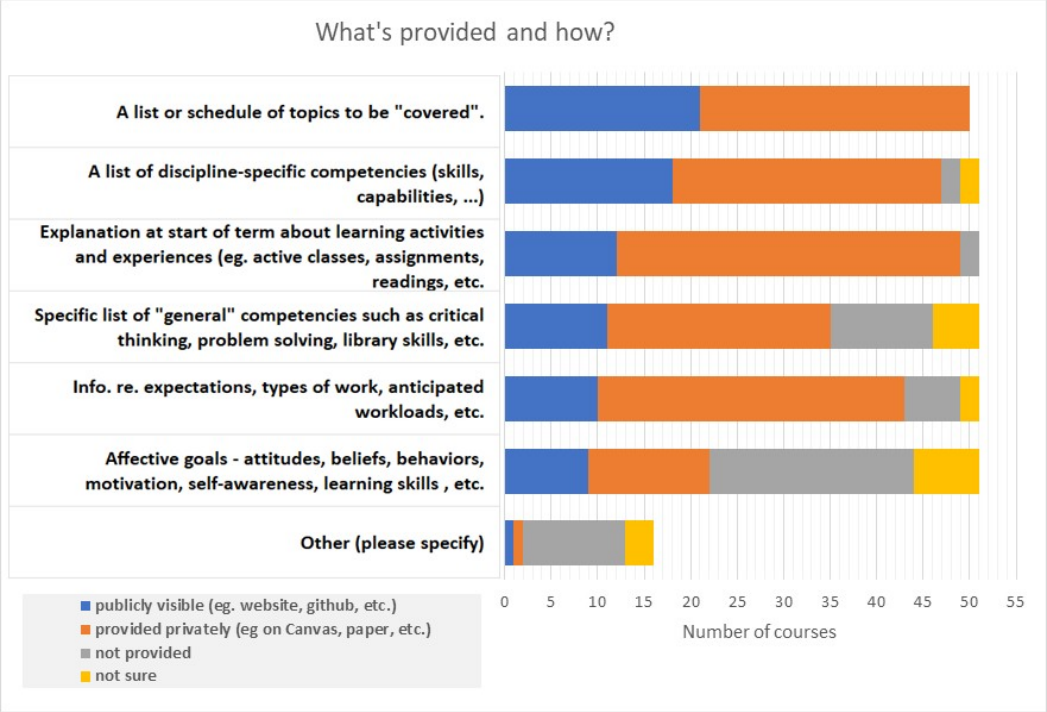
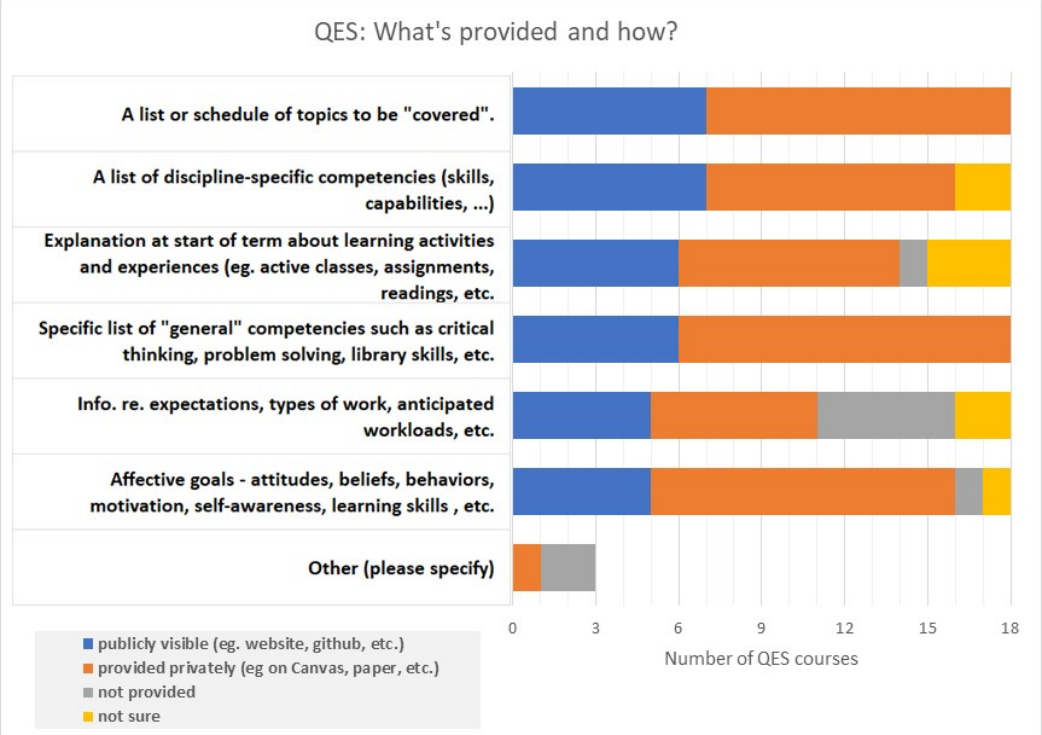


Figure 2b: 18 QES courses only

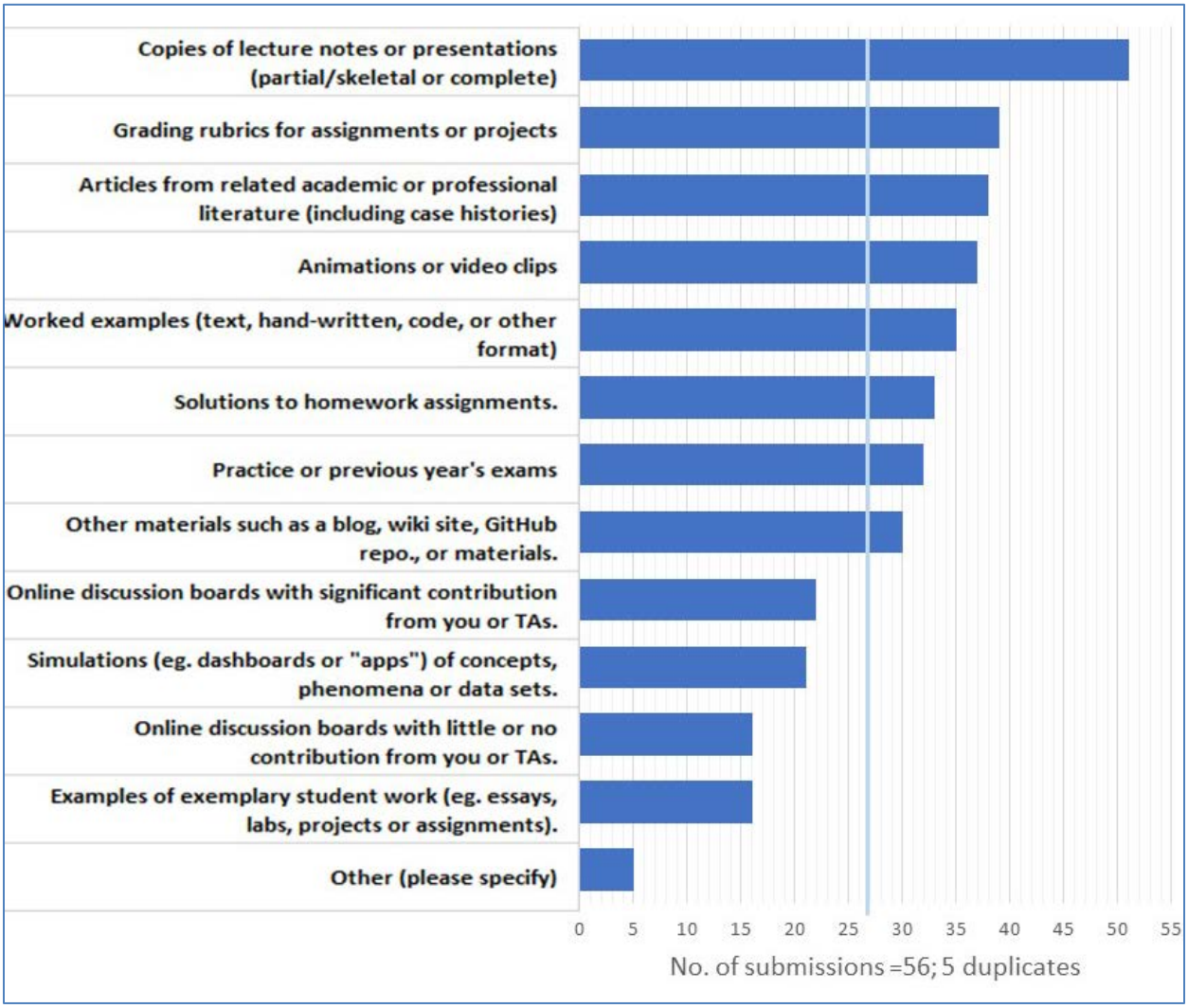


Observations from 18 QES courses; question 2, Figure 2b above.

- Good to see
  - Both “topic lists” and “general competencies lists” are made available in all 18 courses.
- Surprising
  - Information for 11 or more courses is not made publicly visible.
  - Types of work and anticipated workloads are not articulated for 7 of 18 courses. This means students set expectations based on hearsay rather than instructor’s information.
- Recommendations
  - If all information types were part of publicly accessible syllabi, students would have a better chance of choosing relevant courses and setting appropriate expectations.
  - Building syllabi to be compliant with institutional expectations would improve communication to students.

Qn 3: What supporting materials are provided to students at any time during the course?

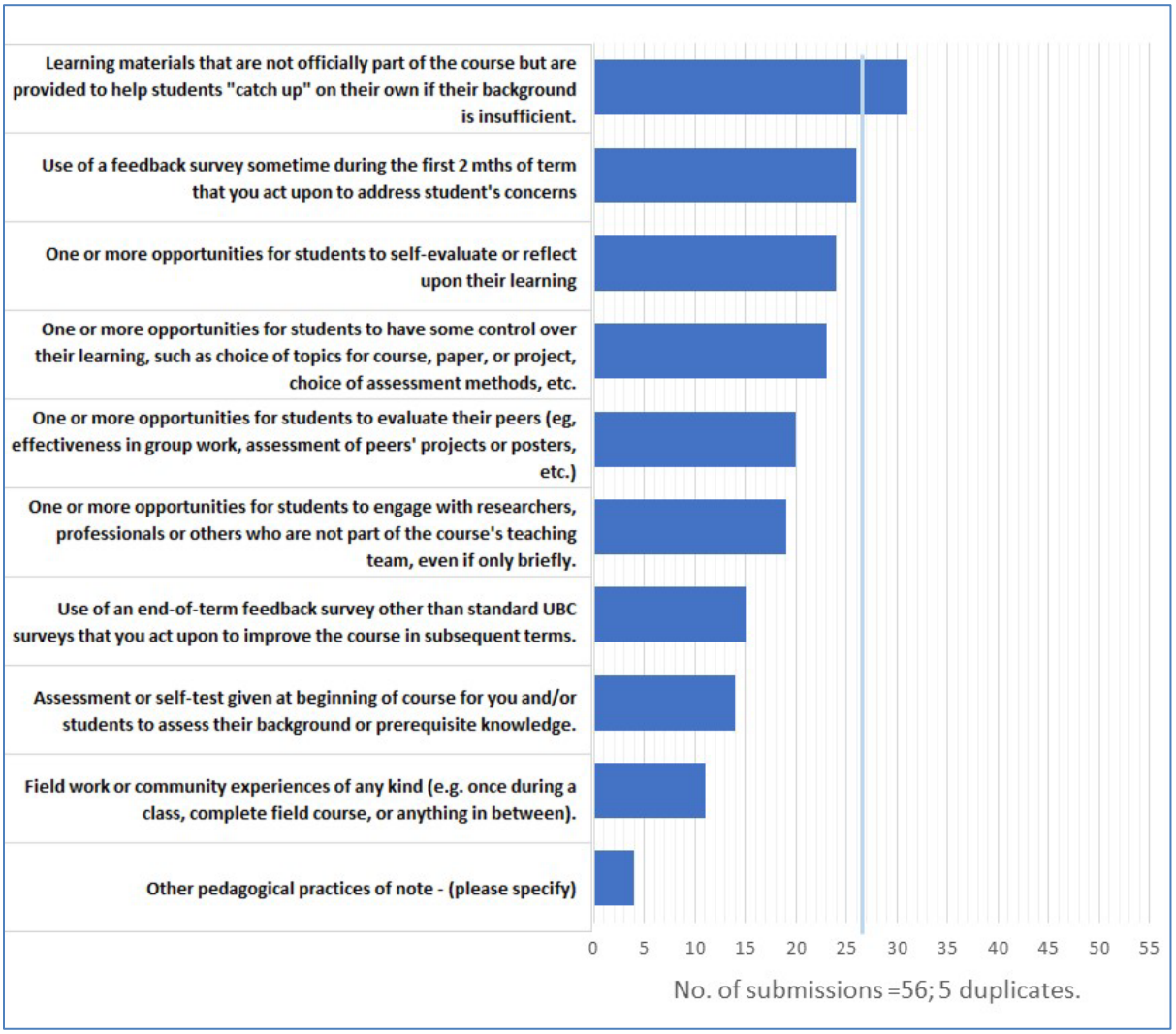
Options were inspired by, or borrowing from, the teaching practices inventory (TPI).



Observations based on 51 courses from Question 3, Figure 3 above.

- Good to see
  - Delivering content is almost ubiquitous. This raises the question of how students use this material and how does it affect their learning habits and behaviors.
  - Academic literature is used in 75%
- Surprising
  - 65% of courses do not provide homework solutions.
  - Moderated / unmoderated discussion boards are used by 43% / 31% of courses.
- Recommendations
  - Increased use of unmoderated discussion boards can be beneficial if they are made relevant. However, they may be less important in labs and similar courses.

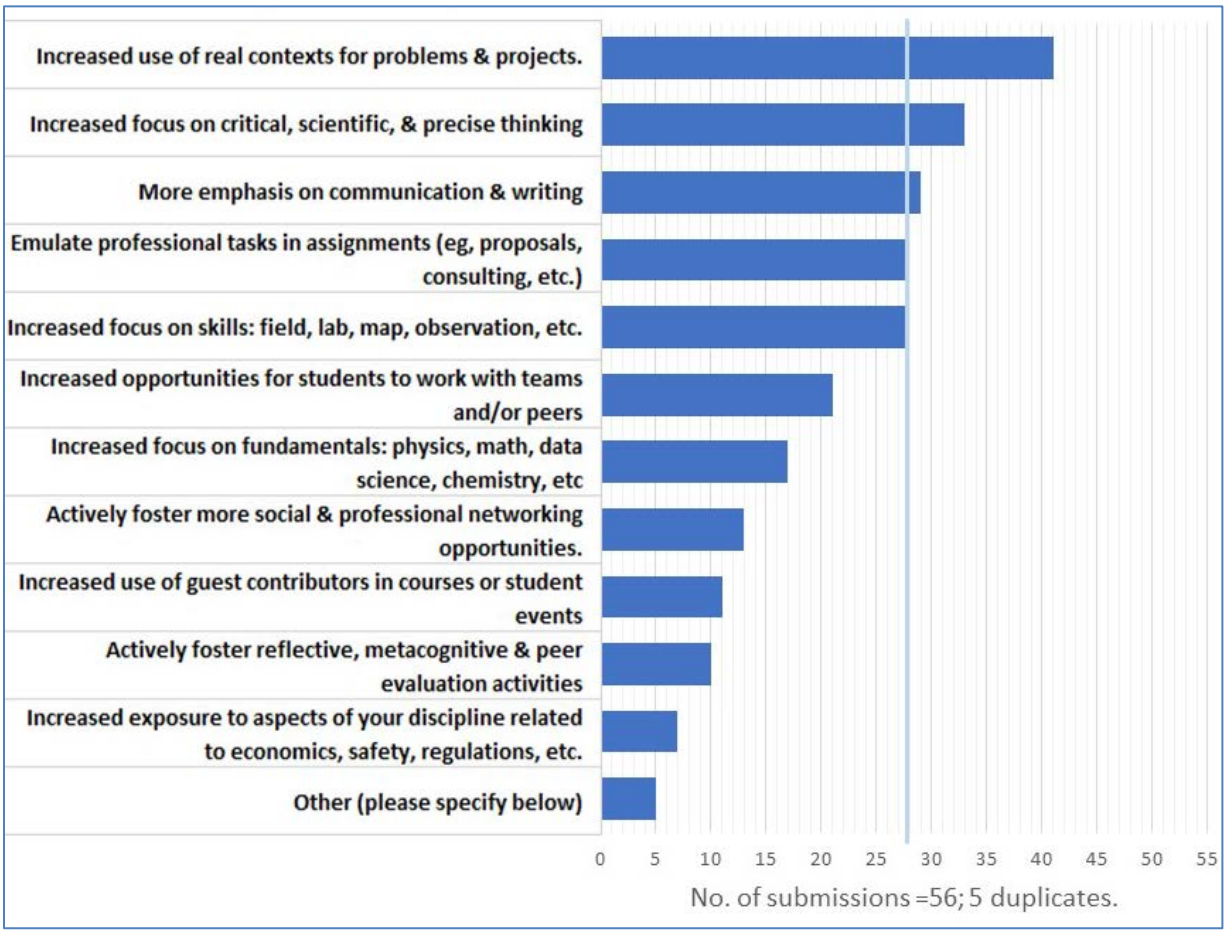
Qn 4: What other pedagogic practices do students experience in this course?



Observations based on 51 courses from Question 4, Figure 4 above.
It is good to see that more than half the courses support "catching up" for students with insufficient backgrounds. Also, although it is challenging to organize, a third of these courses endeavor to expose students to experts who are not officially part of the teaching team.

All 9 of these tactics are considered "pedagogical best practices", yet all but one are used by fewer than half the courses. Instructors are recommended to consider incorporating at least some of these methods to enhance the long term benefits for students. Six of the nine tactics facilitate some form of reflection, self-evaluation, or the giving and receiving of feedback. Such tactics help ensure that both students and instructors can manage the pace and quality of progress.

Qn 5: In your course or across the Department - and assuming that implementation was practical - which five (5) of these tactics do you think would be MOST effective at helping EOAS undergraduate students develop into professionals? Please select your top five choices only.



Question 5 observations and comments based on all 51 courses (Figure 5)
This question essentially asked instructors to offer their own opinion about 11 ways of improving the preparation of students for their post-graduation lives. Interestingly, the top five (each chosen by half or more of respondents) relate to general "professional skills" rather than discipline-specific knowledge or skills.

Tactics suggested as part of this question may be challenging to introduce into some courses, depending on the subject matter, enrollment sizes, and inclinations of instructors. However, it could be argued that there is always a need for enhancing each undergraduate student's future professional capabilities. Research or theoretical aspects of a discipline may be more suitable for emphasis in graduate programs.

Qn 6: Have you any further comments we should know about learning tasks your students experience - or about this survey? (Open ended.)

There were responses from three instructors:

- "*This course is an asynchronous online course with an in-person written final exam.*"
  (Clarifies how the course is run.)
- *"Hard to answer Q3 in a quantitative way for this course. Oh well. I must say, especially this year, my impression is that not enough courses are getting people to answer questions in ways that require them to write code. I get lots of "yes, I took the coding course several years ago, but I don't remember that stuff*"
  (Suggests that one important recommendation is that more attention could be paid to ensure students need to be made to use skills & knowledge in courses that more immediately follow courses in which those skills were developed.)
- *"In this class we review and have group projects on human impacts on the ocean, with a focus on solution development. Students develop outward facing wiki pages, which are also posted to the PME webpage (https://pme.ubc.ca/learn/educator-resources/human-impacts-on-the-ocean/) . The solutions-focus stimulates positive thinking and action. The pages are a product that the students take away with them."*
  (Describes meaningful and inspiring learning outcomes produced by students.)

Appendix: QES courses

The 18 QES courses that contributed to Figures 1b and 2b.

Year level	Course Name	Enrollment
3rd / 4th	Global Climate Change	209
2nd	Meteorology of Storms	94
3rd	Methods in Atmospheric Science	19
3rd / 4th	Renewable Energy Meteorology	80
4th	Numerical Techniques for Ocean, Atmosphere and Earth Scientists	3
3rd	Analysis of Time Series and Inverse Theory for Earth Scientists	10
3rd / 4th	Seismology	3
4th	Geoscientific Data Analysis and Empirical Modelling	34
3rd	Environmental, Geotechnical, and Exploration Geophysics I	43
2nd	Topics in the Earth and Planetary Sciences	47
4th	Physics of the Earth and Other Planets	5
4th	Groundwater Contamination	66
4th	Aqueous Geochemistry	5
3rd	Groundwater Hydrology	69
3rd	Principles of Physical Hydrogeology	43
4th	Chemical Oceanography and Marine Geochemistry	19
3rd	Introductory Oceanography: Circulation and Plankton	133
4th	Waves, Currents, and Mixing in the Ocean	16