Career Learning in Courses

Geophysics or Math

NOTE – FJ added these to Zotero reference library May 30, 2022.

Literature Review

Review literature to identify current examples where **career development is embedded within undergraduate quantitative or interdisciplinary sciences** such as: geophysics, atmospheric sciences, oceanography, math, physics, or data science.

Methods

The following description is a high-level overview of the methods and practices used to review existing teaching and learning literature for intersections with career development.

Inclusion Criteria

- Initially (May 27, 2022) - Geophysics, Math teaching and learning literature
- Not yet included - Atmospheric Sciences, Physics, Statistics/Data Science, Oceanography
- Peer-reviewed
- Scholarly articles
- Scholarly periodicals or association publications
- Last five years

Exclusion Criteria

- Non-science teaching and learning literature
- Publications in languages other than English

A framework for *HOW* career is embedded in a degree experience:

1. **Professional preparation** - activities, lectures, or assignments where students learn about their strengths, write personal philosophy statements, listen to alumni guest speakers, or practice career management skills (resume writing, interviewing, or researching labour market data).
2. **Discipline-specific experiences** - students gain credit for discipline-specific experiential learning like research projects, community-based experiential learning, internships, practicums, co-ops, field school, international study, etc.
3. **Pedagogies and course-design** - students develop future work competencies – like complex problem solving or communication – as a result of activities like presentations, team assignments, real-world case studies, ePortfolios, etc.
4. **Applied learning** - Capstones or applied research projects create opportunities for students to integrate learning from multiple sources or experiences and/or apply theoretical learning to real-world problems.

Browsing

UBC library page
Review journals by subject

The following Journals were identified as relevant sources for potential literature. Consistent search term "career" were used to ensure comprehensive and broad results rather than emphasizing topics like "job search" or "career-readiness" or even "career development".

1. PRIMUS: Problems, Resources, and Issues in Mathematics Undergraduate Studies
2. International Journal of Mathematical Education in Science and Technology
3. Research in Mathematics Education
4. Mathematics and Computer Education
5. Numeracy : advancing education in quantitative literacy
6. Teaching of Mathematics
7. ZDM
8. Mathematical Thinking and Learning
9. Mathematics Education Research Journal
10. Teaching Mathematics and its Applications
11. Physics Education (date range: last 5 years)
12. IOP Science (multiple journals) (date range: last 5 years)

Results

Annotated Bibliography

Based on search results from April 22, 2022 to May 20, 2022. Items marked * are in FJ's Zotero.

Abramovich, S., & Grinshpan, A. Z. (2008)*. Teaching mathematics to non-mathematics majors through applications. *PRIMUS Problems, Resources, and Issues in Mathematics Undergraduate Studies*, *18*(5), 411–428. https://doi.org/10.1080/10511970601182772

This article focuses on the important role of applications in teaching mathematics to students with career paths other than mathematics.

Andrew Hirst, & Veronica Benson. (2021)*. Advice for post-COVID careers. *Physics World*, *34*(11), 54–55. https://iopscience.iop.org/article/10.1088/2058-7058/34/11/43

Magazine article providing field-specific career messaging in light of evolving skills expected by employers following the COVID-19 pandemic. ,". See also the regular Careers column at physicsworld. See also section "Other Options and Ideas" item 6, below.

Ashline, G. (2016)*. Real-World Examples: Developing a Departmental Alumni Network. *PRIMUS Problems, Resources, and Issues in Mathematics Undergraduate Studies*, *27*(6), 598–605. https://doi.org/10.1080/10511970.2016.1234528

Illustrates strategic institutional goals for developing a Math department alumni network, including benefits of such a dynamic, engaging network to students, faculty and alumni.

Atanasov, R., Foguel, T., & Lawson, J. (2013)*. Senior Capstone Seminar: A Comprehensive Learning Experience. *PRIMUS Problems, Resources, and Issues in Mathematics Undergraduate Studies*, *23*(4), 392–402. https://doi.org/10.1080/10511970.2012.748112

Overview of a capstone course where assignments included a resume, math proofs, an article review, and a class presentation. Successes w.r.t. course objectives are discussed. These objectives are:

- Students should exhibit a broad understanding in a range of mathematical areas, encompassing abstraction and formal proof as well as application.
- Students should integrate information from a variety of contexts and sources.
- Students should solve complex problems.

- Students should communicate their mathematical knowledge accurately and effectively, both orally and in writing.
- Students have prepared for a career in the discipline.

Capello, M. A., Shaughnessy, A., & Caslin, E. (Jan. 2021)*. The geophysical sustainability atlas: Mapping geophysics to the un Sustainable Development Goals. *Leading Edge*, *40*(1), 10–24. https://library.seg.org/doi/10.1190/tle40010010.1
FJ favourite article. A powerful link between the 17 U.N. Sustainable Development Goals (sDGs) and field of Geophysics. Clear career application. Detailed, and includes 17 "recommended (web) resources". NOTE: As inspirational content, that this article is is licensed under a Creative Commons Attribution 4.0 International License (CC BY), so any or all can be reproduced, with proper attribution.

Estis, J., & Lewis, D. (2020). View of Improving Mathematics Content Mastery and Enhancing Flexible Problem Solving through Team-Based Inquiry Learning. *Teaching and Learning Inquiry*, *8*(2), 165–183. https://journalhosting.ucalgary.ca/index.php/TLI/article/view/68608/54211
One of many examples of Team or Problem Based Learning in Math. Specific focus on how TBL supports students to **learn workplace competencies** like content mastery, flexibility, problem solving, and communication. Included "standards-based grading", which involves "*assessment based on whether students have mastered the learning objectives (standards) completely or not. Course grades are assigned by counting the number of standards mastered, without regard to when or how (quiz, test, or final exam, for example) the student demonstrated mastery.*"

Jiracek, G. R., Scott Baldridge, W., Biehler, S., Braile, L. W., Ferguson, J. F., Gilpin, B. E., & Alumbaugh, D. L. (2000). SAGE Learning geophysics by immersion. *The Leading Edge*, *19*(9), 986–990. https://doi.org/10.1190/1.1438780 Available do members only.
Description of large-scale, established, field program with multiple institutions, funding agencies, and partnerships with industry. SAGE is still running, and we certainly approve. Maybe we should consider ways of enabling UBC students to participate. See SAGE home page for details. (SAGE is supported by both SEG and AGU.)

Maass, K., & Engeln, K. (2019). Professional development on connections to the world of work in mathematics and science education. *ZDM*, *51*, 967–978. https://doi.org/10.1007/s11858-019-01047-7
Provides a framing of competency, skill, and the invisibility of math within the "world of work" (WoW). Describes an international (13 countries) professional development program for primary and secondary school teachers (not post-secondary) aimed at enabling them to incorporate inquiry-based learning (IBL) into math learning to explicitly address the "world of work". Research focus is on aspects related to the ProD for school teachers rather than on impacts on students or student learning.

Oremland, L. S., & Szabo, C. (2021)*. Preparing Interdisciplinary Problem Solvers: A Project-Based Course Series for the Mathematical/Interdisciplinary Contests in Modeling. *PRIMUS Problems, Resources, and Issues in Mathematics Undergraduate Studies*. https://doi.org/10.1080/10511970.2021.1962460
Describes a 1-credit course designed to prepare employable competencies for students by preparing them for an international math competition. Also a followup 1-credit course involving participation in those competitions. This is an example of the benefits of – and one approach to facilitating – a capstone project-based experiences in STEM.

Rohde Poole, S. B. (2021)*. Designing and Teaching an Undergraduate Mathematical Modeling Course for Mathematics Majors and Minors. *PRIMUS Problems, Resources, and Issues in Mathematics Undergraduate Studies*. https://doi.org/10.1080/10511970.2021.1931995
FJ favourite article. Case history – a comprehensive overview of course design and clear illustration of how intentional choices by instructors helps students to develop transferrable skills and real-world application of knowledge. Good precedent for designing a capstone project-based experience or course.

Other Options and Ideas

1) What **precedent at UBC**? Eg Centre for Community Engaged Learning.
2) For each **course**, ask EOAS teaching faculty which types of activities (Framework above, pg. 1) they include. Could be a survey or a visit or part of an interview. E.g.,
   a) "*How often do students encounter these 4 types of career preparation activities in your course? a) never, b) once, c) 2-4 times, d) 5 or more times.*"
   b) "*Please identify relevant activities in just a few words.*"
3) Ask students the same thing – their **perception** of career-preparation activities they encounter.
4) Do any peer institutions have curricula that are "challenge-based" or that have high-level, persistent contextual threads for learning during the degree programs?
5) Ask SkyLight (Warren Code) or Mathew (Matt) Coles., Education Program Director, UBC Math for discussion about "career preparation" within Quantitative disciplines.
6) Examples and testimonials related to student – industry or community partnerships:
   a) https://wripa.ac.uk/ and organization that brings students and businesses together to foster innovation and retain talent within northern England.
   b) https://www.sepnet.ac.uk/ a a network of nine universities in the South East of England, working together to deliver excellence in physics research, graduate and undergraduate learning and community engagement.
7) Enhance the EOAS "alumni network" – as per Ashline, G. (2016), referenced above.
8) Discuss ways of incorporating a capstone project-based experience (or even a whole course) for QES specializations. The Rohde (2022) article is a good example of benefits, and how to do this.