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Publishing Your Educational Research

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Title: Publishing Your Educational Research
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Abstract: Publishing has always been a part of academic tradition and there is increasing pressure on faculty to publish, even those who carry heavy teaching loads. This manuscript, based on a presentation at the IUBMB 2019 Education Conference session on Publishing in Education, contains suggestions on how to conduct educational research with an eye toward publishing your findings.

There is a difference between educational practice and educational research. In practice, we prepare and present our courses, and assess student learning with exams and exercises. At the end of the term, we look back at areas that were troubling for our students and think of new ways to teach those topics. And we typically repeat this process every semester or every year. In educational research, we explore problem areas more deeply. It is a systematic process with learning goals and learning objectives. Assessments are designed to address those learning goals and objectives, with careful attention to the impact of the changes that are introduced. After repeating this process several semesters, it is possible to collect data on student learning and share that with the broader community.

Learning Goals are broadly applicable, cannot be addressed with a single question on an exam, and provide a framework for creating learning objectives. Here is an example of a learning goal: "Students will understand the effect of pH on protein function."

Learning Objectives address specific measurable tasks and conform to a grading rubric the assess student understanding. An example of a learning objective related to the above learning goal is, "Students will determine the effective pH range for salt bridge formation between lysine and glutamate side chains in a protein."

Blooms Taxonomy is a framework for assessing and designing learning opportunities for our students that was first published in 1956.[1] In 2008, Crowe, Dirks and Wenderoth demonstrated how Blooms taxonomy can be applied to biology with many wonderful examples and helpful insights.[2] In designing a course or an exercise, the taxonomy can be used to consider levels of learning and understanding (Table 1). A simple exploration of the verbs associated with different levels of the taxonomy can be very helpful in moving exercises from superficial levels to deeper levels of understanding (tips.uark.edu/blooms-taxonomy-verb-chart/).

Table I. The Six Levels of Blooms Taxonomy

Level	**Descriptor**	**Characteristic**
I	Knowledge	Memorize presented information
II	Comprehension	Understand and organize information
III	Application	Use acquired knowledge to solve problems
IV	Analysis	Look for cause and effect or inference
V	Synthesis	Combine elements in a new way or proposal alternative solutions
VI	Evaluation	Assess the merits of different approaches

If you are at a crossroads in your career, here are some suggestions to facilitate your transition from an education practitioner to an education researcher.

Commit to Learning New Things

- Learn the vocabulary of education research. For example, read Biology in Bloom and journal about the new concepts that you have encountered. The National Academies Press recently published a book on Discipline-Based Education Research[3] that is also very helpful.
- Identify problems that your students have had consistently for many years?
- Consider how often you modify lab experiments or classroom practices in your teaching. Is this something you could study systematically?
- Learn how students are changing with time.[4]

Read the Education Literature Critically

- Move from asking “How can I use this?” to “Is this a valid approach and why?”
- Explore multiple journals and systematically catalog what is being published.
    - Biochemistry and Molecular Biology Education
    - CBE-Life Sciences Education
    - Journal of Chemical Education
    - Journal of College Science Teaching
    - The Teaching Professor

Attend Education Talks by Published Authors (who may be younger than you)

- Aggressively shift your questions from “What do they know?” to “What can I learn?”
- Set aside counterproductive attitudes
    - Idyllic vision of the past

  - Seniority
  - Resistance to change
- Contact the authors and ask them how they learned to conduct education research.

Attend an Education Workshop

- Ask your department or your dean to pay for you to attend a workshop.
  - IUBMB Education Conference
  - ASBMB Transforming Undergraduate Education in the Molecular Life Sciences education events.
  - Biennial Conference on Chemical Education
- Explore regional or local society web sites for education workshops.
- If you are unable to attend a workshop, search YouTube and Google for "science education research."

Volunteer to Review Articles for the journals listed above.

- Learn the names of the journal's editor and members of editorial board. Connect with them by email or on LinkedIn.
- Commit to reading one education research article each month for a year.
- Commit to reading an entire issue of Biochemistry and Molecular Biology Education.

Select a Focus and Find a Mentor

- Identify a topic or area where your students have consistently struggled.
- List the misconceptions the appear consistently in exams, essays and lab reports.
- Find someone who is already doing research in this area and ask to join their efforts. Note: this step may require multiple phone calls or emails.

Learn Some New Tools

- Add CRISPR to your lab curriculum and evaluate student understanding of its potential.
- Develop skills for data analysis with Excel, Python, R or Jupyter notebook. Implement them in your classroom or teaching lab and assess the resulting changes in your students.

Suggestions for Starting on this Journey

- Read Mindset – The New Psychology of Success [5] or at least watch Carol Dweck's video online (https://www.youtube.com/watch?v=-71zdXCMU6A). Then embrace a growth mindset rather than a fixed mindset.
- Read Grit – the Power of Passion and Perserverance by Angela Duckworth [6] or watch her video (https://www.youtube.com/watch?v=H14bBuluwB8) to prepare for the journey.
- Learn to conduct thought experiments as you consider your future in teaching and education research.
    - Identify a learning difficulty you want to address.
    - Propose multiple solutions.
    - Consider the possible positive and negative impacts of each solution.
    - Set aside unguarded, uninterrupted time to conduct these thought experiments
- Keep a journal of your ideas and aspirations
- Ask someone you admire to mentor you as you grow.

References

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