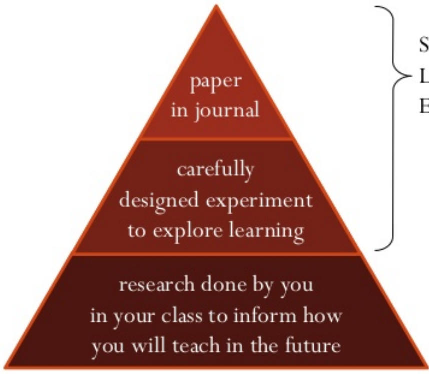
Vocabulary check: SoTL and TAR



Scholarship of Teaching and Learning (SoTL), Education Research

teaching as research

Teaching as Research (TAR)

At the core of improving teaching and learning is the need to accurately determine what students have learned as a result of teaching practices. This is a research problem, to which STEM instructors can effectively apply their research skills and ways of knowing. In so doing, STEM instructors themselves become the agents for change in STEM teaching and learning.

Teaching-as-Research involves the deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and outcomes of students and teachers.

CIRTL Network [1]

What can you study?

Students' attitudes

- what are they initially?
  (e.g., what are students' views on academic integrity?)
- how did they change after you did X?
  (e.g., what do students think about learning goals?)

Students' knowledge and skills

- what are students able to do now that they couldn't do before taking the course?
- are students thinking more like experts?
  (e.g. what questions do they ask in lab/discussion?)

Common education research tools

Quantitative	Qualitative
What is happening?	Why is it happening?

- Multiple choice tests (pre- and post-testing?)
- Attitude surveys (Likert SD, D, N, A, SA scale) CLASS[6]
- mini-writing (muddiest point, think-pair-share, etc.)
- document students'
  - answers on a worksheets
  - responses to a question
  - opinions/views
  - peer instruction votes
  - questions

Humans are involved in TAR

Mission of the Institutional Review Board (IRB):

1. Protection of human subjects from physical harm.
2. Protection of students' privacy and students' success.

If you suspect your research could impact students physical well-being, privacy, or success, you should speak with your IRB. The IRB may insist you **apply for approval** or suggest you **apply for an exemption** from IRB review.

A full inquiry cycle of TAR

1. Learning foundational knowledge
2. Creating objectives for student learning
3. Developing an hypothesis for practices to achieve the learning objectives
4. Defining measures of success
5. Developing and implementing teaching practices within an experimental design
6. Collecting and analyzing data
7. Reflecting, evaluating, and iterating

www.cirtl.net/CoreIdeas/teaching_as_research

Teaching-as-Research

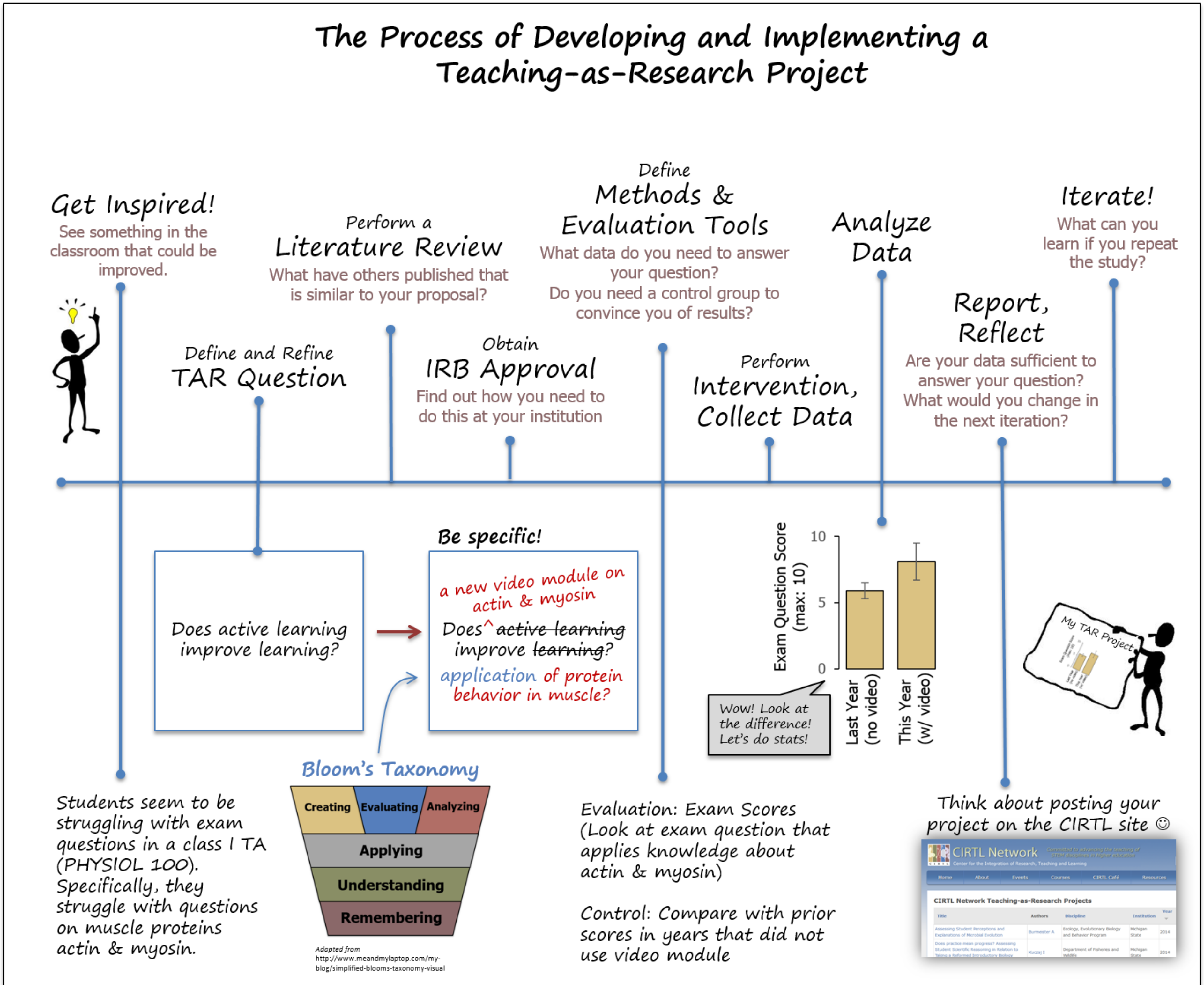
The improvement of teaching and learning is a dynamic and ongoing process, just as is research in any STEM discipline. At the core of improving teaching and learning is the need to accurately determine what students have learned as a result of teaching practices. This is a research problem, to which STEM instructors can effectively apply their research skills and ways of knowing. In so doing, STEM instructors themselves become the agents for change in STEM teaching and learning.

Teaching-as-Research involves the deliberate, systematic, and reflective use of research methods to develop and implement teaching practices that advance the learning experiences and outcomes of students and teachers.

Participants in teaching-as-research apply a research approach to their teaching practice. Conceptual steps in the teaching-as-research process are:

1. Learning foundational knowledge. (What is known about the teaching practice?)
2. Creating objectives for student learning. (What do we want students to learn?)
3. Developing an hypothesis for practices to achieve the learning objectives. (How can we help students succeed with the learning objectives?)
4. Defining measures of success. (What evidence will we need to determine whether students have achieved learning objectives?)
5. Developing and implementing teaching practices within an experimental design. (What will we do in and out of the classroom to enable students to achieve learning objectives?)
6. Collecting and analyzing data. (How will we collect and analyze information to determine what students have learned?)
7. Reflecting, evaluating, and iterating. (How will we use what we have learned to improve our teaching?)

The application of teaching-as-research is meant to lead STEM instructors to a continuous process of discovery and change throughout their careers.



Credit: Laura Slane, University of Wisconsin-Madison

Ray, B., & Bhaskaran, R. (2013). **Integrating simulation into the engineering curriculum: a case study.** *International Journal of Mechanical Engineering Education, 41*(3), 269-280. http://manchester.metapress.com/content/w603n67751488h20/

Abstract
In this paper, we describe improved strategies for teaching computational fluid dynamics (CFD) using the commercial software ANSYS Fluent to upper-level undergraduates and graduate students. We consider a case study from an upper-level elective fluid dynamics course and evaluate various out-of-class learning materials and in-class active learning techniques. We show that, in agreement with previous research, most student learning happens out of class. We show a direct correlation between the materials developed in a reference hand-out and the students' expertise in the area. We introduced i-clickers as a means of promoting active learning in the classroom to emphasize the 'expert approach' in simulation. Their use received a mixed response from the students and we discuss the reasons and a possible remedy. We demonstrate that carefully designed out-of-class learning materials are crucial to students' learning of CFD, and that i-clickers have to be used with care if they are to be effective in engaging students during the lectures. All of these findings inform not only future renditions of this course, but also instruction of CFD in general.

Carrico, K. (2014). **The pedagogy of controversy in the field of China Studies: teaching the Cultural Revolution.** *Learning and Teaching: The International Journal of Higher Education in the Social Sciences, 7*(2). http://dx.doi.org/10.3167/latiss.2014.070203

Abstract
How can we as educators address complex and controversial topics in the social sciences without encouraging simplistic responses and self-reproducing binary oppositions? Drawing upon an ethnographic analysis of a first-year writing seminar on the history of the Chinese Cultural Revolution, this article proposes novel approaches to overcome instinctive reactions to contentious topics. Arguing that the experience of controversy produces self-reinforcing binary oppositions that become autopoetically abstracted from the actual topic of discussion, I build upon specific seminar experiences to propose two novel and practical concepts for the pedagogy of controversy: (1) de-identification, which refers to a process of disengagement from the binaries and thus identities that structure and reproduce controversy, and (2) humanisation, which refers to a process of moving beyond abstractions to re-identify with the fundamentally human experience of contentious historical moments. The pedagogy of controversy, I argue, must teach against our conventional identificatory responses to controversy to promote a more nuanced understanding of inherently complex issues.

Problem-based learning in undergraduate histology: implementation and student perceptions

Kristen Roosa, Cornell University

Presented at the Annual Conference on Case Study Teaching in Science, Fall 2014

Abstract

Problem-based learning (PBL) helps students learn and develop critical thinking skills by solving complex, realistic problems. PBL is common in both medical and basic science courses. Few reports are available on the use of PBL in undergraduate histology, however, which is traditionally taught in a lecture-lab format. In the present study PBL was integrated into a senior-level undergraduate histology course in the form of case studies. Student perceptions and engagement were then evaluated. Two case studies were developed to complement the topics of respiratory tract and female reproductive system histology, which were previously taught by lecture and descriptive lab guide. Histological specimens were provided as digital slides, and post-lab surveys, classroom observations, and student work were used to evaluate the success of the case study assignments. The class rated the activities as enjoyable and useful in post-lab surveys. Students recognized the real-world applications of the cases and the value to their future as medical professionals and scientists. Classroom observations suggested that students were engaged with the cases and motivated to complete them. In addition, many students produced lab reports that included work well beyond what the assignment required, suggesting they were engaged with the case study topics. The PBL activities were well received and successful in this particular course and will likely continue to be a part of the curriculum in the future.

Examining and Developing Teaching and Assessment Tools for helping Students Solve Non-uniformly charged Gauss's Law Problems

Joe Hardcastle and M. Jariwala, Boston University

Unpublished (2013)

Abstract

Electricity and magnetism (E&M) tends to be difficult for students because they have had little exposure with the topics and don't yet have intuition (Maloney et al, 2001). Gauss's law, a law that defines the relationship between electric fields and charges, is introduced early and is of fundamental importance. Previous research has shown that misunderstanding of Gauss's law are common (Isvan & Singh., 2007; Singh., 2006; Maloney et al., 2001) and are even found in physics majors up till their senior and junior year (Pepper et al., 2010). In this work we examined the effectiveness of a recitation session based on a group worksheet and peer discussion in helping students use Gauss's Law. For two semesters we studied these sessions using pre-post worksheet tests and online student surveys. Our results show positive learning gains when comparing pre-post worksheet tests, however student comments suggest continued misunderstandings on the worksheet and pre-post test. Based on these results we hypothesize that this technique is an effective teaching tool for the topic, but requires continued refinement to maximize its effectiveness.

Improving undergraduates' critical thinking skills through peer-learning workshops

Shoshanna Cole, Cornell University

Presented at the American Geophysical Union Fall Meeting, December 2013

Abstract

Critical thinking skills are among the primary learning outcomes of undergraduate education, but they are rarely explicitly taught. Here I present a two-fold study aimed at analyzing undergraduate students' critical thinking and information literacy skills, and explicitly teaching these skills, in an introductory Planetary Science course. The purpose of the research was to examine the students' information-filtering skills and to develop a short series of peer-learning workshops that would enhance these skills in both the students' coursework and their everyday lives. The 4 workshops are designed to be easily adaptable to any college course, with little impact on the instructor's workload. They make use of material related to the course's content, enabling the instructor to complement a pre-existing syllabus while explicitly teaching students skills essential to their academic and non-academic lives.

In order to gain an understanding of undergraduates' existing information-filtering skills, I examined the material that they consider to be appropriate sources for a college paper. I analyzed the Essay 1 bibliographies of a writing-based introductory Planetary Science course for non-majors. The 22 essays cited 135 (non-unique) references, only half of which were deemed suitable by their instructors. I divided the sources into several categories and classified them as recommended, recommended with caution, and unsuitable for this course. The unsuitable sources ranged from peer-reviewed journal articles, which these novice students were not equipped to properly interpret, to websites that cannot be relied upon for scientific information (e.g., factoidz.com, answersingenesis.org).

The workshops aim to improve the students' information-filtering skills by sequentially teaching them to evaluate search engine results, identify claims made on websites and in news articles, evaluate the evidence presented, and identify specific correlation/causation fallacies in news articles and advertisements. Students work in groups of 3-4, discussing worksheet questions that lead them step-by-step through 1) verbalizing their preconceptions of the workshop theme, 2) dissecting instructional materials to discover the cognitive processes they already use, 3) applying skills step-by-step in real-world situations (search engine results, news articles, ads, etc.), and 4) using metacognitive strategies of questioning and reflecting.

Student participants in the pilot study often verbalized metacognition, and retained concepts as evidenced by a post-test conducted 2 months after the first workshop. They additionally reported consciously using skills learned in the workshops over a year later.

Schnabel, L. V., Maza, P. S., Williams, K. M., Irby, N. L., McDaniel, C. M., & Collins, B. G. (2013). **Use of a formal assessment instrument for evaluation of veterinary student surgical skills.** *Veterinary Surgery, 42*(4), 488-496. http://dx.doi.org/10.1111/j.1532-950X.2013.12006.x

Abstract

Objectives

To (1) evaluate the design and use of a global rating scale assessment instrument in veterinary medical education and; (2) examine the effectiveness of 2 surgical techniques courses for improving the surgical skills of veterinary students.

Study Design

Instrument development; observational; survey-based.

Sample Population

Students (n = 16) registered for 2 elective surgical techniques courses were enrolled on a volunteer basis.

Methods

A 5-point global rating scale instrument was designed for the evaluation of 12 basic surgical skills by faculty evaluators and used to obtain student start and end scores during the courses. Upon conclusion of the courses, students completed a survey from which their opinions on their improvement as well as their desire for feedback were obtained.

Results

All authors agreed the instrument was easy to use. As groups, 3rd year students, 4th year students, and all students combined had significantly higher total skill scores at the end of the courses compared to the start of the courses. Individually, 10 students (63%) had significant improvement in surgical skills as a result of their participation in the courses: 4 (100%) 3rd year and 6 (50%) 4th year students. Student survey responses revealed a strong desire for feedback as well as support of formal assessment methods. Only weak agreement was found between student opinions on their improvement and the authors' assessment scores.

Conclusions

Assessment instruments are useful for (1) student evaluation and (2) for providing students with feedback on their surgical skills.

Exercise: Refining a Teaching as Research project

You decide to redesign your course in order to make it more collaborative and interactive with the goal of increasing student engagement. The course is currently taught in a large lecture with very little interactions between students and the instructor. You want to divide the large lecture into three smaller sections that will each meet once a week. The lectures will be recorded and watched online by all students. You're also teaching two sections of this same class every fall semester.

RESEARCH QUESTION – FIRST ATTEMPT

How effective will this new class format be for the students? Will they be more engaged? Will they learn more?

RESEARCH QUESTION – REVISED

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POSSIBLE SOURCES OF EVIDENCE

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POSSIBLE METHODOLOGY OR ASSESSMENTS TO ADDRESS THE QUESTION

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