Thoughts on Adding Civic Engagement Elements into Courses for STEM Major

It seems simple, but -----

Opinion!

1) Civic Engagement can be an excellent tool for engaging students, helping students take responsibility for their learning, and making students successful in class;

2) I really believe that a college education should generate responsible citizens - it is the right thing to do; however,

3) It is <u>not</u> likely that I can solve world problems in my general chemistry class, CH105/CH106.

So, the Motivation for Civic Engagement is -

To help students engage in the learning process and take responsibility for their learning

and

To experience real life applications, see content in context, exercise critical thinking, and address social responsibility.

The Caution is -

while change is a necessary & integral part of Teaching and Learning; change away from traditions has its risks and can depend upon:

1) Teacher Personality/Comfort Level,

2) University/Departmental Culture, and

3) Student Expectations.

So,

do

design, innovate, evolve, and create in the context of your teaching environment.

Change has always been around!

As we consider

Changes in Stem Courses,

perhaps,

recognition of some of the changes proposed

in Stem Teaching is relevant.

OK, a list of a few curricular reforms is helpful,

but

a discussion of each is <u>not</u> the point of this presentation!

1) **POGIL** - **http://www.pogil.org** POGIL is an acronym for Process Oriented Guided Inquiry Learning. POGIL guided inquiry – a learning cycle of exploration, concept invention, and application;

2) **SENCER** – **http://www.sencer.net** - **"Us"** **(Civic Engagement)**

SENCER is an acronym for Science Education for New Civic Engagements and Responsibilities. SENCER courses and programs strengthen student learning and interest in the sciences, technology, engineering, and mathematics by connecting course topics to issues of critical local, national, and global importance.

3) **College Board Curricular Changes:**

http://advancesinap.collegeboard.org

New curricular frameworks for Biology, Chemistry, and Physics are currently being implemented.

4) **MOOCs (Massive Open Online Courses)/Hybrids/ Flipped:**

We are currently hearing a fair amount about this new initiative. A report (January 2013) Changing Courses: Ten Years of Tracking Online Education in the United States, Dr. Elaine Allen (Professor of Biostatistics & Epidemiology @ UCSF and Co-Director of Babson Survey Research Group) and Dr. Jeff Seaman (Co-Director of Babson Survey Research Group). --- **bsrg@babson.edu**

Teaching and Learning

It may be convenient think of Teaching & Learning in three parts:

1) Course Content (the what)

2) Assessment of Learning

- **a) formative (is it working) &**
- **b) summative (did it work)**

3) Process or Context of Delivery (the how*)

***the how** –> really contributes to students to engagement in learning <u>**or**</u> taking responsibility for their learning!

1) Course Content (the what) is Course Specific

In General Chemistry for science majors and Organic Chemistry, the content of the top textbooks is nearly the same.

So, often there is reasonable agreement on what should be taught and learned.

2) How is the course going?

Let me suggest that "we" in Higher Education have recently passed through a period of major considerations of Assessment - to our credit and sometimes to our frustration - ☺.

Ok, it (assessment) may still be a work in progress.

3) Perhaps, the Art of it all (How)?

The process of delivery and context of the content has a major impact on the learning of, engagement in, and retention by our students

and

also the motivation to continue in the major or area of study.

Perhaps, the challenges of integrating Civic Engagement into STEM courses can be considered in three curricular environments:

1) Courses for non-majors – (general education),
2) Upper level courses for majors, and
3) Lower level courses for majors* (often seen as foundational).

* very likely the greatest challenge for curricular reform!

Civic Engagement into Chemistry Courses

1) Civic engagement in courses for Non-Science Majors which often meet general education requirements is easily done, is the major focus of current gen-ed courses, and has been done, - i.e. Chemistry in Context.

2) Civic engagement in upper level courses for Science Majors can be done, - i.e. Analytical Chemistry. At the upper level there is a need to help the student move to the next phase of their career by adding relevance.

3) Lower Level Foundational Courses for science majors (i.e. General Chemistry and Organic Chemistry) are often viewed as content intensive or content important with foundational material/content needed for the rest of the curriculum. The challenge is often seen as the "time" to cover the content.

Civic engagement can be used to support the learning and retention of content with relevant examples and activities. "Pearls" or short Civic Engagement activities can also be used to engage the students and support the learning of the content.

Content vs Time

Perhaps, the laboratory offers some relief from the time vs content concern:

Make the laboratories relevant and in the contexts of the students lives.

Real sample vs brown bottle samples when possible

Addressing the Challenges

1) Use civic engagement to <u>support</u> not <u>replace</u> valuable content.

2) Civic engagement can be a <u>tool</u> for engaging students and helping them take responsibility for their learning.

3) It is not an issue of <u>replacing content</u>, but putting content in context and supporting learning and retention of the content.

Good Teaching Goals

Marriage of :

- **Content and its Relevance,**
- **Critical Thinking,**
- **Data Collection and Evaluation,**
- **Student Engagement in Content and Learning,**
- **Writing, Organization, and Presentation,**
- **Team Work and Communication, and**
- **Project Completion and Closure.**

All supported by civic engagement elements in STEM courses

Thank – you ☺

A few Traditional Examples:
Generate activities or stories around

Determination of buffer capacity in a blood buffer system and relate it to kinds of reagents that most often dumped in the blood.

Calculate the pH before and after an given amount of exercise generates a given amount of lactic acid in the blood.

Identify intermediates and catalyst for the reaction mechanism describing the depletion of ozone in the atmosphere.

Calculate the acid content in an antacid tablet from titration data.

Extract a given amount of current for a given amount of time from a galvanic cell then calculate the voltage before and after the process.

Calculate the heat content is a food sample from calorimetric data.

Determine the relative polarities of ibuprofen and aspirin from TLC data using a polar stationary phase.

Identify polar or nonpolar sites in the ibuprofen molecule.

Assay local water sources.

Others ?????