

Improving Student Learning Through "Tuning"



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Outline

- I. Description of the "Tuning" Process
 - a. In general
 - b. As realized in Utah
- II. Physics Learning Outcomes Developed through Tuning
- III. Opportunities Growing out of Tuning

What Is "Tuning"?

- Faculty and Student representatives jointly define what a student must
 - Know
 - Understand
 - Be able to doto qualify for a degree in physics at associate, bachelor, and masters levels.

What Is "Tuning"?

- Faculty driven - we define the discipline
- Multi-institution process (state-wide in our case)
- Across educational sectors (universities to community colleges)
- Shift the focus to student outcomes more than faculty inputs, from seat time and credits to learning

What Is "Tuning"?

- Discipline by discipline: Sing in the same key, though not in unison
 - Agree on outcomes, not how to get there
 - Agree on levels of expectation, not how to assess
 - Pay attention to needs of alums, students, employers, etc.

Furthering a Cultural Change initiated by accreditors and institutions

- Focus on what students learn
 - Shift focus of faculty discussions to learning more than teaching
 - Focus interactions with students on what they are learning (or not) and why
 - Focus assessment on required learning outcomes
 - Report to accreditors on what students have learned and how it has been assessed

Tuning Consultations

- Consult other stakeholders, to inform faculty as they define the discipline - and open lines of communication
 - Students
 - Alumni
 - Employers
 - Policy makers
 - Administrators, Advisors, Librarians
 - K-12 representatives

Utah "Tuning" Overview

- Faculty from 8 state institutions (UU, USU, Weber, UVU, SUU, Dixie, Snow, SLCC) and 1 private university (BYU) plus USOE (representing public education)
- One student representative (UVU, then UU)

Utah "Tuning" Overview

- Developed list of BS-level learning outcomes (LOs), then 2-year-level for transfer and MS-level
- Surveyed students, faculty, alumni, and employers
- Focus group with employers of physics graduates
- Shared ideas on assessment of LOs
- Reported to university/college leaders

Define the Discipline

- Our work began with in-depth discussion of our joint discipline
 - How do we define it?
 - What are the essential competencies?
 - What competencies are taught in other departments? In ours?
 - The central discipline, not specializations at this point
 - Always remember that Tuning is not standardization

General Competencies

Examples of highly ranked general competencies:

- Oral and written communication
- Abstract thinking, analysis and synthesis
- Essential knowledge and understanding of academic subjects and profession
- Reasoned decision-making
- Capacity to learn and update learning

Discipline Competencies: Physics

3 Categories of Competencies

- Physics Knowledge
- Laboratory and Computer Skills
- Scientific Communication and Research

Competencies to LOs

- Define learning outcomes (LOs) at the associate's, bachelor's, and master's levels
- No prescription of how different institutions bring students to achieve the LOs - institutional autonomy in curriculum, pedagogy, and assessment - but share ideas

The "Ratchet Principle"

Ratchet up levels at which competencies are achieved from Associate's to Bachelor's to Master's to Doctoral level

Learning Outcome Example

Students shall demonstrate

- Ability to organize problems by identifying physical principles, identifying relevant vs. irrelevant quantities, and making appropriate diagrams

Concrete Examples

Physics team created benchmark examples to concretize the ratcheting of expectations

Levels of Sophistication

1. Ability to identify physical laws by name and to provide definitions of important terms related to the physical laws
2. Understanding of the meaning of physical laws and knowledge of their general formulas
3. Ability to apply the general formulas or concepts to specific limited situations

Levels of Sophistication (2)

4. Ability to design or describe experiments that could test a specific formula
5. Understanding of the limits of validity of general formulas and the domains of validity of physical theories
6. Understanding how empirical science functions, i.e. the supremacy of experiment and observation in establishing physical theory

Levels of Sophistication (3)

7. Ability to apply physical laws across different subdisciplines of physics and appreciation of common threads
8. Ability to construct specific formulas for specific situations from established general formulas
9. Understanding of general physical principles outside the context of their mathematical expression

Levels of Sophistication (4)

10. Ability to construct mathematical models from general principles without reference to other specific, limited-use formulas
11. Ability to teach effectively and see where common pitfalls in understanding occur

Opportunities from Tuning

- Exchange ideas with physics faculty, students, alumni, and employers throughout the state
- Coordinate curriculum with LOs to improve both learning and efficiency
- Further the cultural change to thoughtful assessment that is being driven by accreditors

Example of Curriculum Coordination with Tuning

- LOs call for students to be able to
 - Use dimensional analysis to verify physical meaning and check results.
 - Estimate orders of magnitude of physics quantities; estimate orders of magnitude of solutions to physics problems; explain how to identify quickly whether a problem solution or other physics quantity is of reasonable magnitude.
- Could be addressed in several courses, but who takes responsibility to focus on this?

Other Goals of Tuning

- Improve accountability & consistency in outcomes across programs and institutions
- Bring transparency to students, employers, others
- Communicate better about student learning with students, alumni, faculty, advisors, librarians, employers, legislatures, parents

What Does Tuning Ask of Us?

Using degree-level LOs

- Review curriculum to correlate LOs with our courses and levels
- Review assessment practices to align with LOs
- Make expectations embodied in LOs explicit for students and for employers

References

- Article, "Strengthening Student Learning Through 'Tuning'", William E. Evenson, Synesis 2012, T:18-24
 - http://synesisjournal.com/vol3_t/Evenson_2012_T18-24.pdf
- Utah Tuning website
 - <http://utahtuning.weebly.com>