Tuning Physics in Utah

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PRE-TUNING, FACULTY STYLE

1992: Faculty-driven meetings on transfer

1993: Faculty-driven General Education Task Force
      Now, Regents’ General Education Task Force

1998: Faculty began meeting in some academic disciplines
      Two- to four-year transfer

1999: “What is an Educated Person” Conference
UNINTENDED PRESCIENCE

Process Faculty Driven

Regents’ General Education Task Force

Unknowingly Prepared for Tuning
FACULTY MAJORS’ MEETINGS

- 1999: 32 academic disciplines met
- Clear transfer and articulation policy
- Learning outcomes (goals) in each area
  - math, composition, life science, social science, humanities, fine arts
FACULTY MAJORS’ MEETINGS

- 2004: Legislative intrusion
- Common course numbers
- Lower division
  - Similarity in content, standard and rigor
KISMET

• Association of American Colleges and Universities (AAC&U)
  ◦ Greater Expectations
  ◦ Coherence in curriculum
  ◦ Assessment models
Essential Learning Outcomes (ELOs)

- Multiyear dialogues with many colleges
- Analysis of reports from business/industry
- Analysis of accreditation requirements for engineering, business, nursing and teacher education
## Essential Learning Outcomes

- **Knowledge of Human Cultures and Physical and Natural Work**
  - (science, math, social sciences, history, languages, arts)

- **Intellectual and Practical Skills**
  - (inquiry, critical thinking, written/oral communication, teamwork, problem solving)
Essential Learning Outcomes

• Personal and Social Responsibility
  ◦ (civil knowledge and engagement, ethical reasoning and action, intercultural knowledge)

• Integrative and Applied Learning
  ◦ (synthesis, advanced accomplishment across generalized and specialized studies)
Preparation meets Opportunity

Bologna
Tuning
ELOs
LUMINA

Utah was Prepared!
What Is “Tuning”? 

- Discipline by discipline: Sing in the same key, though not necessarily the same song
  - Agree on outcomes, not how to get there!
  - Agree on levels of expectation, not how to evaluate
  - Faculty driven!
  - Pay attention to needs of alums, students, employers, etc.

- Harmonize – singing in unison is not the goal!
Who Does “Tuning”? 

- FACULTY IN THE DISCIPLINE!
- STUDENT REPRESENTATIVES
- State-wide Team representing all higher education sectors
- Team members nominated by their departments and institutions
Faculty-driven Process

- Define Outcomes / Competencies
- Define levels of expectation for the outcomes
- Map employability of physics majors
- Evaluate degrees and programs against achievement of agreed-upon outcomes
- Create “Degree Profiles” by institution
Surveys

- Input to Tuning Team discussion of outcomes for degrees
- General competencies: students, recent graduates, employers, faculty
- Discipline-specific competencies: faculty
- Carried out by administrative support with Team input
Physics Tuning in Utah

- State Team with representatives from all nine USHE institutions (2-yr, 4-yr, MS, Research)
- Agree on essential competencies
- Levels of expectation, ratcheted up
Physics Tuning in Utah

- Outcomes statements for competencies and descriptions of levels of expectation
- Employability Map
- Degree Profiles
Learning Outcomes Categories

- Knowledge / understanding
- Application
- Fluency in using increasingly complex info
- Communication: breadth and depth of topics, range of audiences
- Autonomy for subsequent learning
General Competencies: Examples

1. Ability to communicate both orally and through the written word in native language

2. Ability to work autonomously

3. Ability to evaluate and maintain the quality of work produced
Utah Physics Competencies Themes

1. Nature of Science, Nature of Physics
2. Mathematical Skills, Modeling, and Problem Solving
3. Physics Concepts
4. Laboratory Skills
Utah Physics Competencies Themes

5. Scientific Communication (written, oral, and visual communication)

6. Computational and Information Skills

7. Research
Competencies within Themes

5. Scientific Communication (written, oral, and visual communication)

- Writing: complete, punctuated sentences, well organized, good logic
- Scientific writing: able to explain in words rather than equations
- Presentation skills: informal presentations to peers, formal presentations
- Teaching at 4-year and 6-year levels; ability to impart knowledge to others
Example: Nature of Science, Nature of Physics

The 2-year student should be able to:

- Understand that physics is possible because nature is predictable/understandable; physics is interesting because nature is not too simple.
- Understand that physics is not a collection of facts or tables of numbers, or even a set of immutable laws, but rather a process to gain knowledge about the physical world.
- Understand that scientific theories must be testable....
More Ratcheting

The BS/BA student should be able to:

• Do everything on the 2-year student list in addition to:

• Understanding the interplay between theoretical and experimental progress in physics.

• Understanding the self-correcting properties and mechanisms of science.

• Putting major advances in physics in historical context and knowing about the people involved. . . .
Employability Maps

- 2-year physics students are prepared to move to a BS/BA program.
- BS/BA in physics prepares students for employment in
  - Electronics industry
  - Aerospace industry
  - Other scientific and engineering industry
  - Graduate school in physics
  - Professional schools in law, medicine . . .
HISTORY

Three Major Learning Outcomes:
- Historical Knowledge
- Historical Thinking
- Historical Skills
History Learning Outcomes

- **Historical Knowledge**
  - Surveys, change over time, causation, influence of political, economics, social, cultural, race, gender, ethnicity

- **Historical Thinking**
  - Context of past, complexity/diversity, problematic nature of interpretation
History Learning Outcomes

- Historical Skills
  - Critical thinking, critical reading, primary sources, research, historical argument

- Development of assessment rubric
  - Five point scale from excellent mastery to no mastery
Degree Profiles

Each institution describes its degrees and programs in physics

- knowledge and abilities graduates must demonstrate
- what students are prepared for
- strengths and unique qualities of the program
- possible emphases

...
Benefits of the Tuning Process

- Explicit learning outcomes
- Assessable
- Shifts the focus from input (lengths of a learning experience, type of institution) to what a person holding a particular qualification actually knows and is able to do.
More Benefits of Tuning

- Supports a better match between the needs of the labor market and education
- Facilitates the transfer and use of qualifications across different education systems
- Facilitates validation of non-traditional learning
Recommendations

- Community College Roles
  - Course and curriculum articulation
  - See 4-year institutions as “employers”
  - Accountability and Assessment – set up systems to show what students have gained at your institution
Recommendations

- Faculty Groups – learn to work together among different types of institutions
- Coordinate with Private Institutions – our students also attend these
- Increase transparency and accountability through Tuning
Afterthoughts

- Continue Tuning physics & history
- Introduce Tuning to the other 30 disciplines
- Work towards accountability through
  - Educational Resumés
    - Assessable evidence of student learning
- Develop systems for faculty to engage departments
Challenges of Tuning

- Not easily scalable
- Commitment to frequent faculty meetings
- Faculty in charge
- Resources needed
What is Lost by not Tuning

- Coherence in curriculum
- Improvement of teaching/learning
- Transparency and accountability
- Coherence with professional associations and accreditation
- Better frameworks for understanding what our students learn
TUNING

- Utah aspires to be in
  - Perfect Tune
    - Throughout its
      - entire curriculum