PaSCoR ... from Space

Developing & Assessing PaSCoR Courses
Workshop
Lueny Morell & Rosa Buxeda
December 17, 1999
Ponce Hilton
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Workshop Goal & Objectives

• Provide a guide to develop PaSCoR Courses and assess student learning outcomes
  – Establish the importance of planning.
  – Become aware of learning styles & the impact on course/Course development.
  – Develop Course goals & objectives.
  – Design classroom activities to achieve Course goals & objectives.
  – Identify assessment strategies to evaluate student performance & learning.
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Agenda

9:00 – 9:40 am  Workshop Goal and Objectives
                PaSCoR Educational Paradigm
                PaSCoR Course Template

9:40 – 10:15  Course Description and Topics

10:15 –10:40  Break

10:40 – 12:00  Course Objectives & Skills
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Agenda…

12:00 – 1:30  Lunch
1:30 – 2:15  PaSCoR Student Learning profile
            Teaching & Learning Strategies
2:15 – 3:00  Assessment strategy
3:00 – 3:30  Break
3:30 – 4:30  Putting together the template
4:30 – 5:00  Presentations
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## Educational Paradigm

<table>
<thead>
<tr>
<th>INCOMING STUDENTS</th>
<th>EDUCATIONAL PROCESS</th>
<th>GRADUATES</th>
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<tbody>
<tr>
<td>Who are our students? What is their back-ground? Skills?</td>
<td>What do we need to do in order to develop the professional we want? Experiences?</td>
<td>What do we want? What kind of engineer or scientist we want? Profile? Skills?</td>
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</tbody>
</table>
Paradigm...

• Education should:
  – increase *both knowledge & skills*
  – promote new attitudes & values

• Educational process should be designed to:
  – maximize & enhance the student’s knowledge base & skills
  – develop an individual who is a self-learner & thinks critically
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Project Model
The "Learning Factory" Concept
An outcomes-based, student centered initiative

Students

\begin{itemize}
  \item Curriculum
  \item Undergraduate Research
  \item Mentoring & Counseling
  \item Internships
  \item Seminars & Workshops
\end{itemize}

\begin{itemize}
  \item GIS/RS knowledge
  \item Skills
    \begin{itemize}
      \item profession
      \item graduate school
    \end{itemize}
  \item Values
    \begin{itemize}
      \item diversity
      \item teamwork
      \item global awareness
      \item communication
    \end{itemize}
\end{itemize}

PaSCoR Graduates
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PaSCoR Courses Main Focus

– outcomes-based
– practice-based, hands-on educational experiences
– balance traditional scientific & mathematical principles with practical experiences
– development of skills
– compliance with ABET 2000
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The “Learning Factory” Curriculum Model

Diagram 2: Model Curriculum Alternative Track RS/GIS

- Freshman year course
  - Introduction to RS
  - Introduction to GIS
  - 2 electives
- Undergraduate research
- Integrated research activities
- RS/GIS Professional
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Question

• What does the course syllabus represent to you?
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The syllabus or course plan

- The instrument that reflects the course design and establishes what is required and expected from the student
  - Course objectives
    - Content & skills
  - Educational activities to achieve goals/objectives
    - Traditional (e.g., lecture)
    - Non-traditional (e.g., hands on lab activities, team experiences, industrial interaction)
  - Outcomes Assessment
    - traditional (e.g., exams) and custom-made (e.g, to evaluate teamwork)
PaSCoR Courses

• Course Title
• Description
• General Objectives and Skills
• Course Outline
• Student Outcomes Assessment & Evaluation Criteria
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Course Design

- Common format/template
  - WORD 7, Power Point 7
- Be available through electronic means
- Team developed
  - Share strategies & assessment tools
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Course Development Steps

• Step 1: Establish Rationale
• Step 2: Define General Objectives and Student Outcomes (Instructional Objectives)
• Step 3: Design Teaching/Learning Strategies
• Step 4: Develop Criteria/Tools to Assess Student Performance/Outcomes
• Step 5: Determine Special Contacts Needed
• Step 6: Pilot test & assessment
• Step 7: Re-engineer & Report
Why establish instructional objectives?

• Identify critical course material
• Facilitate the design of in-class activities
• Facilitate effective student evaluation
• Focuses the student’s attention on learning tasks by telling what they can expect...
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Instructional Objectives

• Example: “At the end of this (course, week, lecture), the student will be able to…”

• “… is an action word like:
  – calculate, estimate, solve, derive
  – describe, compare, distinguish, list
  – explain, outline, construct…”

• Can be measured
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Bloom’s Cognitive Objectives

• Cognitive Domain
• Affective Domain
• Psychomotor Domain
• Levels
  – Knowledge
  – Comprehension
  – Application
  – Analysis
  – Synthesis
  – Evaluation
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KNOWLEDGE

- Remember previously learned material.
- Lowest level of learning outcome.
- Recognize or recall information about specifics, terminology, facts, methodology, classifications and sequences.
- Verbs to use: define, repeat, name, identify, relate, remember...
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COMPREHENSION

• Ability to understand the meaning of the information.
• Represents the lowest level of understanding.
• Verbs to be use: describe, explain, discuss, identify…
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APPLICATION

• Ability to use learned material in new and concrete situations.
• Represents a higher level of understanding than comprehension.
• Verbs to be use: apply, interpret, demonstrate, illustrate, use...
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ANALYSIS

• Ability to break down material into its components parts.
• Represents a higher level of understanding than comprehension.
• Verbs to be use: calculate, solve, compare, contrast, categorize, derive, model.
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SYNTHESIS

- Ability to put parts together into a whole.
- Creative behavior is stress.
- Verb to use: Create, invent, predict, construct, design, imagine, improve, produce, propose...
EVALUATION

- Ability to judge the value of the material for a given purpose.
- The highest level of intellectual activity.
- Verb to use: judge, select, decide, critique, justify, verify, debate, assess, recommend, argue.
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SKILLS

• The Graduating SMET Profile
  – Team work
  – Problem solving
  – Communication
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ABET 2000 a-k competencies

a. ability to apply knowledge of math, science & engineering
b. ability to design & conduct experiments, analyze data
c. ability to design a system component or process
d. ability to function on multi-disciplinary teams
e. ability to identify, solve & formulate engineering problems
f. understanding of professional & ethical responsibilities
g. ability to communicate effectively
h. understand the impact of engineering solutions in a global & societal context
i. life-long learning
j. knowledge of contemporary issues
k. ability to use techniques, skills & engineering tools necessary for engineering practice
Example of Student Outcomes

- Clearly defines a need/problem and analyzes the situation
- Clearly establishes goals & objectives for product/process & defines a work-plan
- Timely follows a work-plan
- Accurately demonstrates knowledge from his/her area of expertise, & integrates other areas
- Communicates ideas clearly, both in written reports & oral presentations
- Facilitates effective interpersonal/inter-team relationships
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Course Development Steps

- **Step 1**: Establish Rationale
  - Course title (page 1)
  - General description (page 1)
  - Identify topics to be covered (page 2, column 1)
  - Establish:
    - class size
    - faculty/student ratio
    - role of instructor
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Steps...

• Step 2: Define General Objectives and Student Learning Outcomes (Instructional Objectives) (page 1):
  • Student Outcomes
    – What do you expect students to learn?
    – What do you expect students will be able to do with what they learn?
  • Determine what specific skills & competencies will be developed in the students
    – Bloom’s taxonomy
    – ABET 2000 a-k skills & competencies
    – recommended by constituents
      » industry
      » Other (See PR-AMP Skills for the Millenium)
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Steps...

• Remember to consider all cognitive levels
  – All PaSCoR courses/modules must include the development of (at least) the following:
    ➢ diversity
    ➢ team work
    ➢ global awareness
    ➢ ethics
    ➢ communication
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How do students learn?

- Learning Style Model, Felder 1988
  - Perception - Sensory, Intuitive
  - Input Modality - Visual, Verbal
  - Organization - Inductive, Deductive
  - Processing - Active, Reflexive
  - Understanding - Sequential, Global
PaSCoR Student Profile

PaSCoR Student Learning Styles (Felder, 1988)

- **PERCEPTION**
  - sensory
  - intuitive

- **INPUT MODALITY**
  - visual
  - verbal

- **PROCESSING**
  - active
  - reflective

- **UNDERSTANDING**
  - sequential
  - global

FRESHMEN

UPPER LEVEL
Teaching/Learning Strategies

• Are relative to the course objectives.
• Establish relevance and applications for all course material.
• Should balance concrete information (facts, observation) and abstract concepts (model, theory).
• Should use a variety of delivery modes (e.g., use pictures, schematics and graphs, videotapes, demonstrations, hands-on) to address most of learning styles.
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Teaching/Learning Strategies

• Use numbers, not just algebraic variables.
• Give time to think.
• Use cooperative learning (small group exercises)
• Use computer-assisted instruction.
• Assign open-ended problems for analysis and synthesis.
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Traditional and Non-traditional Teaching/Learning Strategies

- Lectures
- In-class demonstrations
- Laboratory experiences
- Consultations
- Field trips to industry
- Oral presentations
- Written reports
- Working in teams
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**Teaching/learning Strategies**

**Suggested by Wankat**

**TEACHING AND LEARNING ACTIVITIES (Harb et al., 1991; McCarthy, 1987; Svinicki and Dixon, 1987)**

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<th>Diverger (1)</th>
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<th>Converger (3)</th>
<th>Accomodator (4)</th>
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<td>Motivation</td>
<td>Information and Facts</td>
<td>Try it</td>
<td>Do it themselves</td>
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<td>“War stories”</td>
<td>Lecture</td>
<td>Homework problems</td>
<td>Self-select projects</td>
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<td>Brainstorming</td>
<td>Reading</td>
<td>Laboratory</td>
<td>Design</td>
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<td>Observation:</td>
<td>Instructor or TV demonstration</td>
<td>Simulations</td>
<td>Open-ended problems</td>
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<tr>
<td>Role Playing</td>
<td>Patterns</td>
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<td>Write problems</td>
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<td>Organizing</td>
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<td>Problem-solving examples</td>
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<td>Tinker</td>
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<td>Record</td>
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<tr>
<td></td>
<td></td>
<td>Make things work</td>
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Steps...

• **Step 3**: Design Teaching/Learning Strategies (page 2)
  
  • What classroom/lab activities & strategies will be necessary for students to learn the desired concepts?
  
  • What classroom (or otherwise) activities & strategies will be necessary for students to develop desired skills & competencies?

  • Examples:
    
    – lectures, labs, demos, field trips, professionals in the classroom, working in teams, coop learning, oral presentations, written reports, etc. (See *Wankat*)
How to Evaluate Student Performance?

• Depends on Course goals/objectives

• Tools
  – Traditional & Non-traditional
    • exams, quizzes, homework,
    • oral reports
    • written reports
    • team experiences

• Assessment Tools Examples
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Steps...

- **Step 4: Develop Criteria/Tools to Assess Student Performance/Outcomes (page 3)**
  - specific criteria
    - how will you know if students have learned concepts and developed skills?
  - traditional tools (tests, quizzes, homework)
  - non-traditional assessment tools/instruments
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Steps...

• Step 5: Determine Special Contacts Needed
  – Laboratory Facilities
    • LARSIP (Pieter VanDerMeer, ext. 3510, email: pvander@ece.uprm.edu)
    • LARSIP AS Extension (L. Olivieri, ext., 2092, email: l_olivieri@rumac.upr.clu.edu)
  – Industry collaboration
  – Other
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Steps…

• **Step 6:** Pilot test & assessment
  – All course materials & assessment tools ready
    • Word/Power Point format & in electronic means (to be posted on PaSCoR web-site)

• **Step 7:** Re-engineer & Report
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# PaSCoR ... from Space

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10/16/00

[Image: NASA Logo] [Image: UPR Logo]
## Resources

### PASCoR Team Addresses

<table>
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<tr>
<th>NAME</th>
<th>DEPARTMENT</th>
<th>TELEPHONE</th>
<th>FAX</th>
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</thead>
<tbody>
<tr>
<td>Robert Acar</td>
<td>Math</td>
<td>X 3732</td>
<td></td>
<td><a href="mailto:acar@cs.upr.clu.edu">acar@cs.upr.clu.edu</a></td>
</tr>
<tr>
<td>Jorge I. Vélez</td>
<td>Business Adm.</td>
<td>265-6380</td>
<td></td>
<td><a href="mailto:jvelez@ece.uprm.edu">jvelez@ece.uprm.edu</a></td>
</tr>
<tr>
<td>Pieter van der Meer</td>
<td>LARSIP</td>
<td>X 3753, 3780</td>
<td>831-7564</td>
<td><a href="mailto:pvander@ece.uprm.edu">pvander@ece.uprm.edu</a></td>
</tr>
<tr>
<td>Hamed Parsiani</td>
<td>INEL</td>
<td>X 3653</td>
<td></td>
<td><a href="mailto:parsiani@ece.uprm.edu">parsiani@ece.uprm.edu</a></td>
</tr>
<tr>
<td>Pamela Jansma</td>
<td>Geology</td>
<td>X 3579</td>
<td>265-3845</td>
<td><a href="mailto:pam@geology.uprm.edu">pam@geology.uprm.edu</a></td>
</tr>
<tr>
<td>Luis Olivieri</td>
<td>Agronomy</td>
<td>X 2092</td>
<td>833-7765</td>
<td><a href="mailto:l.olivieri@rumac.upr.clu.edu">l.olivieri@rumac.upr.clu.edu</a></td>
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<tr>
<td>Rosa Buxeda</td>
<td>Biology</td>
<td>X 2174 Casa 832-5786</td>
<td>265-3837, 265-1225</td>
<td><a href="mailto:r_buxeda@rumac.upr.clu.edu">r_buxeda@rumac.upr.clu.edu</a></td>
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<tr>
<td>Ramón Vásquez</td>
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<td>X 2402</td>
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<tr>
<td>Luis Jiménez</td>
<td>INEL</td>
<td>X 3248 Celular 510-3481</td>
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<td><a href="mailto:Jimenez@ece.uprm.edu">Jimenez@ece.uprm.edu</a></td>
</tr>
<tr>
<td>Josefita González</td>
<td>Eng. Academic Affairs office</td>
<td>X 3826</td>
<td></td>
<td><a href="mailto:jgonzalez@engdean.upr.clu.edu">jgonzalez@engdean.upr.clu.edu</a></td>
</tr>
<tr>
<td>Lueny Morell</td>
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PaSCoR … from Space

Resources

• PaSCoR course syllabus template
• Sample IQ 4016 syllabus
• Description of Bloom’s Major Categories
• “Objectively Speaking”, paper, R.M. Felder
• Some assessment tools