Science for future elementary teachers: Views of faculty

Charles Mamolo and Dean Zollman
Kansas State University
Physics Education Research Group

Rationale (1 of 4)

NOT Highly Qualified Science Teachers (a world problem)
- KSDE report 1467 or 13.1%
- Kansas teachers over 50 years of age increased
  - 27% in 1999-00 to 34% in 2004-05,
  - 24% (8,455) of all teachers (33,819) will be eligible to retire
  in the next five years.
- About 8% turnover ratio

Demand Problem

Rationale (2 of 4)

Supply Problem

Rationale (3 of 4)

Big Picture

Rationale (4 of 4)

RESEARCH STATEMENT:
The impact of the science curriculum in future elementary teachers' area of concentration decision

Data Source I
Faculty Interviews

Data Source II
Student Surveys

Data Source III
Student Interviews
General Science Courses

Recommended Courses

- Biological
  - Biol 198 Principles of Biology w/ lab (4 hrs)
- Physical
  - Phys 106 Concepts of Physics w/ lab (4 hrs)
  - Chem 110 General Chemistry (3 hrs)
- Earth Science
  - Geol 100 Earth in Action (3 hrs)
  - Geog 221 Environmental Geography w/ lab (4 hrs)

Participants’ Profile

<table>
<thead>
<tr>
<th>Professor</th>
<th>Rank</th>
<th>Teaching Experience</th>
<th>Years at KSU</th>
<th>Course for Future Elem. Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Instructor</td>
<td>&gt; 7</td>
<td>&gt; 3</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Scholar</td>
<td>&gt; 3</td>
<td>&gt; 3</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Asst. Prof.</td>
<td>&gt; 10</td>
<td>&gt; 1</td>
<td>Yes</td>
</tr>
<tr>
<td>4</td>
<td>Assoc. Prof.</td>
<td>&gt; 10</td>
<td>&gt; 5</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Full Prof.</td>
<td>&gt; 15</td>
<td>&gt; 10</td>
<td>No</td>
</tr>
</tbody>
</table>

Five Natural Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Students per Class</th>
<th>Laboratory Integration</th>
<th>Laboratory Grade into Final Grade</th>
<th>Use of Technology</th>
<th>Human Resources</th>
<th>Pedagogy</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol 198</td>
<td>~90</td>
<td>Yes</td>
<td>Yes</td>
<td>Computer Sim.</td>
<td>4-6</td>
<td>Studio</td>
<td>5 Exams</td>
</tr>
<tr>
<td>Chem 110</td>
<td>150-250</td>
<td>No</td>
<td>No</td>
<td>None</td>
<td>1</td>
<td>Lecture</td>
<td>5 Exams</td>
</tr>
<tr>
<td>Geol 100</td>
<td>~ 50</td>
<td>No</td>
<td>Yes</td>
<td>Clickers</td>
<td>1</td>
<td>Lecture</td>
<td>Some PCK</td>
</tr>
<tr>
<td>Phys 106</td>
<td>~90</td>
<td>Yes</td>
<td>Yes</td>
<td>PCK</td>
<td>1</td>
<td>Lecture</td>
<td>Exploration, Application, PDA, Lab, Assignment, 4 Exams</td>
</tr>
<tr>
<td>Geog 221</td>
<td>~250</td>
<td>No</td>
<td>Yes</td>
<td>None</td>
<td>1</td>
<td>Lecture</td>
<td>4 Exams</td>
</tr>
</tbody>
</table>

Course Goals or Plan Curriculum

- Introduce “scientific method” (2/5)
  - what and how of things
- Solve sophisticated scientific problems (4/5)
  - application from one context into another context
- Introduce real life applications or scientific issues (3/5)
  - global warming, designing of drugs, potable water, natural disasters
- Conceptual understanding (5/5)
  - geosphere, hydrosphere, processes and patterns, breadth of the science of biology
- Understanding of concepts as applied to elementary school children (2/5)

Teaching Strategies

- Passive Teaching
  - Partial Notes (1/5)
  - Lecture (5/5)

- Active Teaching
  - Novice Teaching Asst. (2/5)
  - Clickers & PDAs (2/5)
  - Textbook and/or Lab. Manual (5/5)
  - Expert Teaching Asst. (2/5)
  - Studio Format (1/5)
  - Learning Cycle (1/5)
  - Turn to Your Partner (4/5)

- Student Attitudes and Beliefs: “making the connection”

Big Picture Question

- Feeling of understanding of their surroundings better (5/5)
- Good citizens - to make wise choices through critical thinking (1/5)
  - separate facts from garbage
- Feeling of not the “evil” science class (1/5)
- Gain science confidence and bridge content and teaching (2/5)
- Transfer learning to other classes (immediate impact) (2/5)
Educating Future Elem. Teachers

- No idea or will do the same (ex. studio format) - (1/5)
- Breadth of Content: "good grasped of good science" - strong foundation (1/5)
- Less is More (1/5)
- Couple content and pedagogy - Pedagogical Content Knowledge (PCK) (2/5)
  - learning styles, concept maps
  - Modeling PCK
    - Ex. Integrate science into other classes (english, math)
  - Individual Projects and Group Projects
- Build confidence (2/5)
- Connecting Science Standards into lessons (2/5)
- Science impact to daily life (2/5)

Teaching Kids Science

- Feed on curiosity, be engaged, allow questions
  - What do you see? What does it mean? How do you test it?
- Foster the element of discovery
  - help students think about the world around them
  - science is something one can do
- Connection to things one has experienced

Future Course Improvements

- Separate majors and non-majors (1/5)
- Allow more active engagement (smaller class size and unbolted chairs and tables) (1/5)
  - Ex. answering worksheets in class
  - peer collaboration
- Teaching Assistants’ Professional Development
  - Study the avenue of getting assistants from COE who have done the course previously (1/5)
- Incorporate metacognition (few questions) (1/5)
- Scout for inexpensive readily available materials for class use that students can replicate when they are already teaching. (1/5)

Summary

- Range of learning strategies depending on “connection” to educational background and available technological resources.
  - a) Passive vs Active  b) Pure content vs PCK
- There are tacit goals.
- There seems to be a disparity between the perception on how kids should learn science and teaching science to future science teachers.
- A question: To what degree should science faculty feel responsible in the quantity and quality of future science teachers?

Thank you !!!

Email: cbmamolo@phys.ksu.edu