Branches from the Same Tree:
Growing STEM and Humanities Together at UK

Allison Elliott-Shannon
Barbara Knutson
Akiko Takenaka
Land Grant Universities vs. Liberal Arts Colleges

**Land Grant Universities**

- Morrill Act (1862) tied the industrial and education needs of each state to these state-funded universities
- Large and varying in exclusivity
- Include work force development
- Humanities disciplines may not be highly emphasized outside student’s major

**Liberal Arts Colleges**

- Small and elite
- Employ humanities curriculum to facilitate student learning
- Humanities disciplines emphasized outside student’s major

https://www.ucop.edu/institutional-research-academic-planning/_files/value-uc-humanities-degree.pdf
https://www.foxnews.com/us/liberal-arts-colleges-face-existential-threat
Impact of 2008 Recession

- Decreased state funding
  - Severe contraction of funding of public university systems
- Increased student tuition
  - As tuition increased, students post degree expectations changed (make money)
- Changing expectations
  - Financial security versus “learning”
  - View of college as “job training”

Changes in Kentucky’s General Fund Appropriations 2008 to 2018

Source: Kentucky Budgets of the Commonwealth
Push to STEM: Post 2008 Decade

- Decline in humanities degrees more impactful at Liberal Arts Colleges (33% to less than 25%) than Research Universities (17% to 11%)

Changing Expectations: Job Demand

Perception
Lower demand for degrees in humanities

Unemployment Rates for Liberal Arts Graduates

<table>
<thead>
<tr>
<th>Category</th>
<th>Unemployment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recent liberal arts graduates</td>
<td>5.2%</td>
</tr>
<tr>
<td>Mature workers with liberal arts degrees</td>
<td>3.5%</td>
</tr>
<tr>
<td>(ages 41-50)</td>
<td></td>
</tr>
<tr>
<td>Mature workers with professional or preprofessional degrees (ages 41-50)</td>
<td>3.46%</td>
</tr>
</tbody>
</table>

Reality
A 2013 survey of 318 employers with 25 or more employees showing that nearly all of them thought that the ability to “think critically, communicate clearly, and solve complex problems”—the precise objectives of a liberal arts education—was more important than a job candidate's specific major.

Source: 2013 Association of American Colleges & Universities Survey

https://www.dailytarheel.com/article/2018/02/humanities-major-income-0213
Changing Expectations: Wage Gap

Perception
• Lower salaries for humanities degrees

Reality
“Initially high economic return to applied STEM degrees declines by more than 50 percent in the first decade of working life. This coincides with a rapid exit of college graduates from STEM occupations.”

• STEM jobs skills change, leading to flatter age-earnings profiles as the skills of older cohorts became obsolete

• Lower salaries for humanities degrees are also attributed to the gender wage gap

The Public Policy of Humanities vs. STEM

**Rewarding STEM**
- States are rewarding public colleges and universities for students educated in fields seen as important to the economy
- At least 15 states offer some type of bonus or premium for certain high-demand degrees

**De-emphasizing Humanities**
- Portrayal of liberal arts education as expendable or a luxury
- “Taxpayers should not have to pay for a liberal arts education”
State Funds vs. Tuition and Fees as Revenue Sources

FY 2010

- State Funds: 53%
- Tuition and Fees: 47%

FY 2010

- State Funds: 31%
- Tuition and Fees: 69%
State Appropriations to UK, net of debt service (in millions)
FY 2018: Kentucky Legislature Institutes Performance-Based Funding for Public Universities
What Does Performance-Based Funding Reward?

- Growth in bachelor’s degrees awarded.
- Growth in STEM + Health undergraduate degrees.
- Retention at 30, 60, 90 hours.
- Earned undergraduate credit hours.
- Instructional square feet.
- Direct cost of instruction.
- FTE student growth.
Performance Funding Model for the Public Universities Where Rates of Growth Exceeded Sector Average FY 2018-19 to FY 2019-20

<table>
<thead>
<tr>
<th>Performance Metric</th>
<th>UK</th>
<th>UofL</th>
<th>EKU</th>
<th>KSU</th>
<th>MoSU</th>
<th>MuSU</th>
<th>NKU</th>
<th>WKU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bachelor's Degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM+H Bachelor's Degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>URM Bachelor's Degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Income Bachelor's Degrees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Progression @ 30 Hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Progression @ 60 Hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student Progression @ 90 Hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earned Credit Hours</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operational Support Activity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructional Square Feet</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Cost of Instruction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FTE Students</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metrics Above Sector Average</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: Council on Postsecondary Education
UK and Performance-Based Funding

- UK excels at Performance-Based Funding
- We receive more from the pool than we lose in appropriations
Rising New Enrollments Fall 2011 - Fall 2018

https://www.uky.edu/iraa/student-data
Upward trend for total undergraduate enrollment

https://www.uky.edu/iraa/student-data
Why the dip in total enrollment 2016 to present?

Improved retention and graduation rates.

https://www.uky.edu/iraa/student-data
Shifting Enrollments at UK: STEM + H vs. Liberal Arts
STEM + Health Majors Rising....

UK STEM + H Undergraduate Enrollment

https://www.uky.edu/iraa/student-data
…but humanities and non-STEM majors losing enrollments.

https://www.uky.edu/iraa/student-data
The makeup of our undergraduate study body’s academic focus is changing...

2009-10 UK Undergraduate Enrollment

- Non-STEM: 66%
- STEM + H: 34%

https://www.uky.edu/iraa/student-data
2018-19 UK Undergraduate Enrollment

- Non-STEM: 56%
- STEM + H: 44%

...with STEM + H majors closer to dominance.

https://www.uky.edu/iraa/student-data
Winners and Losers at UK: Examples of Program Growth and Decline at UK

Selected Majors Over Time

https://www.uky.edu/iraa/student-data
Winners and Losers in Kentucky: Regional Universities Hard-Hit

- Morehead State Univ. and Kentucky State Univ. in distress
- Eastern Kentucky Univ. program cuts, salary freezes
- The most economically vulnerable Kentucky students attend regional campuses, where humanities degree programs are disincentivized and in danger of closure
Q: How can UK lead in this situation?
Q: How can UK lead in this situation?

A: Use our flagship status and strength to pilot collaborative solutions that unite STEM + Humanities.
University of Tulsa “True Commitment” Strategic Plan

• Reduction of degree programs offered by 40 percent

• “University Studies Program” for incoming freshmen
  Arts and Sciences departments → interdisciplinary programs
  • Fine Arts and Media
  • Humanities and Social Justice
  • Human Biology and Behavior
  • Ecology, Environment, and Sustainability
Similar proposals:

University of Central Missouri

• Elimination of the College of Arts, Humanities, and Social Sciences
• Departments such as English, history, and philosophy to be merged with programs from the College of Education
• Art, music, and dance departments to share a college structure with sciences, statistics, and technology.

University of Wisconsin at Stevens Point

• Elimination of 13 majors primarily in the liberal arts
THE INTEGRATION OF THE Humanities and Arts WITH Sciences, Engineering, and Medicine IN HIGHER EDUCATION

Branches FROM the Same Tree
Incorporating Arts and Humanities into STEM courses and curricula:

• Skills: communication, critical thinking, problem solving, leading

• Creative and effective scientists, engineers, technologists, and healthcare providers

• Understanding of the broad social and cultural impacts of applying knowledge to address challenges and opportunities in the workplace and their communities
BOX 7-3
Integration of Art Making to Improve Clinical Observations

Plastic surgery residents participate in a figure sculpting workshop taught by 2011 Virginia Commonwealth University (VCU) sculpture alumna, Morgan Yaco, in a partnership with the Center for Craniofacial Care at the Children’s Hospital of Richmond at VCU directed by plastic surgeon Jennifer Rhodes. “Plastic surgery and sculpture have a great deal of crossover,” says Rhodes, “I have Morgan willing to provide our division with a class here in Richmond is a fantastic opportunity for us to enrich our resident experience by encouraging them to think creatively, fostering an appreciation of subtle anatomic details and applying their anatomy knowledge in a different way.”

SOURCE: https://www.news.vcu.edu/health/The_surgeon_as_sculptor.

BOX 7-4
Medical Illustration

David Goodsell’s watercolor painting of autophagy depicts the process by which a yeast cell packages waste material and delivers it to a vacuole. Courtesy of David S. Goodsell/Scripps Research Institute.

SOURCE: https://www.ami.org/medical-illustration/enter-the-profession/education/graduate-programs.
Incorporating STEM into Arts and Humanities courses and curricula:

• Scientific literacy

• All-around education

• Basic understanding of the scientific and technical details of lives and environments

• Scientific and technological context of the artists’ and humanists’ craft
Human Biology in Health and Disease

Description
Despite our differences, each of us has a body that functions to keep us alive. This course examines the structure and function of the human body from investigative and interdisciplinary perspectives. We will consider how the various organ systems work to maintain life and the ways in which the functions of these systems can be compromised by disease. Participants will explore how scientific methods are used to learn about the biology of humans. In addition to more traditional laboratory exercises, teams of students will design, carry out, and report on a laboratory project related to human biology. This course should be well-suited for students majoring in social work and other areas where a general understanding of human biology would be useful, as well as for students interested in learning more about human biology under normal and pathological conditions.

Science and Technology of Everyday Life

Description
Modern society would not exist without the aid of technology. We depend upon technological devices for communication, food production, transportation, health care and even entertainment. This course focuses on the wide variety of technology used in everyday life. The objective is to develop a familiarity with how various technological devices work, and to explain the basic scientific principles underlying their operation. Topics covered include: the automobile, radio, television, cellphones, microwave ovens, computers, ultrasound, and x-ray imaging. Concepts from basic science are introduced as they appear in the context of technology. Laboratory projects include construction of simple objects such as radios, electric motors, and a musical keyboard.
# Home Page

<table>
<thead>
<tr>
<th>Instructor:</th>
<th>Lou Bloomfield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time:</td>
<td>MWF 1:00pm - 1:50pm (schedule)</td>
</tr>
<tr>
<td>Location:</td>
<td>Physics 203</td>
</tr>
</tbody>
</table>
| Office Hours: | Mondays, 3:00pm - 5:00pm, Alderman Cafe (in Alderman Library)  
Wednesdays, 9:00am – 11:00am, Room 133, Physics Building |

## Description:
Physics 1050 is for non-science majors. It is a practical introduction to physics and science in everyday life. This course considers objects from our daily environment and focuses on their principles of operation, histories, and relationships to one another. The emphasis for Physics 1050 is on mechanical and thermal objects. The companion course, Physics 1060, emphasizes objects involving electromagnetism, light, special materials, and nuclear energy.

## Required:
WileyPlus Access, which includes the Online Textbook and eTextbook

Preferred: iClicker2

## To obtain a WileyPlus Access code from UVA Bookstore’s Inclusive Access Program:
- Log into UVACollab
- Select the UVACollab site for this class (19F PHYS 1050 HTW)
- Choose “UVA Bookstore Digital Access” and follow instructions there

## Course Materials:
- To register WileyPlus Access code:
  - Follow the instructions on this flyer.
- To use WileyPlus, the textbook, and complete coursework:
  - Go to WileyPlus Site
Outcomes

• Increased critical thinking abilities
• Higher-order thinking and deeper learning
• Content mastery
• Problem solving
• Teamwork and communication skills
• Improved visuospatial reasoning
• General engagement and enjoyment of learning
Outcomes

• Increased critical thinking abilities
• Higher-order thinking and deeper learning
• Content mastery
• Problem solving
• Teamwork and communication skills
• Improved visuospatial reasoning
• General engagement and enjoyment of learning

The outcomes align with qualities that employers are seeking
National Academy of Sciences
Recommendations:

• Support for integrative approaches
• Evaluating integrative courses and programs
• Enhancing inclusivity through integrative courses and programs

Advantages of UK:

• Co-location on single campus
• Number and diversity of disciplines
• 128 credit hour limitation to complete a major. Unlike other universities, we are not increasing the credit hours of our STEM majors. This leaves room for broader coursework.
• Existing collaborations and courses
• Evaluation Center in College of Education
• Honors College as a model for reimagining humanities-STEM interactions
“All religions, arts and sciences are branches of the same tree. All these aspirations are directed toward ennobling man's life, lifting it from the sphere of mere physical existence and leading the individual towards freedom.”

- Albert Einstein