Augsburg PKAL-TIDES Initial Proposal [Draft!]

Teaching to Increase Diversity in STEM
Proposal by
Dr. Milo Schield,
Management Information Systems Coordinator

AACU-PKAL issue a Call for Proposals

Goal: to increase the “participation, retention and graduation of underrepresented groups in STEM.” “to reach nearly 100,000 students”
Objective: “(Re)Design of multi-disciplinary curriculum that will enhance underrepresented student interest, competencies and retention in the computer/information sciences and related STEM disciplines.”
www.aacu.org/pkal/tides/cfp.cfm

Funded by the Helmsley Trust

“In postsecondary education, the Trust is primarily interested in increasing the number of Science, Technology, Engineering and Mathematics (STEM) graduates who can participate in high growth sectors of the economy.”

“The Trust also focuses on policy levers that improve postsecondary completion, particularly for underrepresented populations.”
www.aacu.org/pkal/tides/cfp.cfm

Minority Population Growing; 4 million+ in 2008

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>White (Non-Hispanic)</td>
<td>6,768</td>
<td>6,628</td>
<td>7,159</td>
<td>7,187</td>
</tr>
<tr>
<td>Black</td>
<td>723</td>
<td>995</td>
<td>1,313</td>
<td>1,565</td>
</tr>
<tr>
<td>Hispanic</td>
<td>358</td>
<td>618</td>
<td>901</td>
<td>1,092</td>
</tr>
<tr>
<td>Am. Indian</td>
<td>48</td>
<td>77</td>
<td>96</td>
<td>169</td>
</tr>
<tr>
<td>Asian/Pacific</td>
<td>357</td>
<td>576</td>
<td>700</td>
<td>823</td>
</tr>
<tr>
<td>Other</td>
<td>324</td>
<td>440</td>
<td>493</td>
<td>556</td>
</tr>
<tr>
<td>Total</td>
<td>8,578</td>
<td>9,364</td>
<td>11,008</td>
<td>12,132</td>
</tr>
<tr>
<td>Non-White</td>
<td>1,810</td>
<td>2,766</td>
<td>3,583</td>
<td>4,145</td>
</tr>
</tbody>
</table>

Source: Table 275 2011 US Statistical Abstract

Individual Multi-Million Dollar Awards by NSF

- Effects of College Degree Program Culture on Female and Minority Student STEM Participation: #0525408; 2005; $1,328,310.
- Greater Minority STEM Participation Through Academic Opportunity and Institutional Change: #0450339; 2005; $8,780,323.
- Sustainability of best practices for minority STEM student retention and success: #0342041 2003; $2,500,000.

STEM Graduation Problem: Minorities

Percentage of Freshmen at four-year colleges intending to major in STEM who graduate with STEM majors:

<table>
<thead>
<tr>
<th>STEM MAJORS</th>
<th>Black</th>
<th>Amer.</th>
<th>Hispanic</th>
<th>Non-Hisp</th>
<th>White</th>
<th>Asian</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-yr Grad Rate</td>
<td>18%</td>
<td>19%</td>
<td>22%</td>
<td>33%</td>
<td>42%</td>
<td></td>
</tr>
<tr>
<td>Comparison with White rate</td>
<td>-45%</td>
<td>-42%</td>
<td>-33%</td>
<td>0%</td>
<td>27%</td>
<td></td>
</tr>
</tbody>
</table>

Most under-represented: Women!

Over-represented: blacks, Asians, Other
Under-represented: women, Hispanics, whites.

<table>
<thead>
<tr>
<th>US Bachelor's Degrees: 2009-2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEM</td>
</tr>
<tr>
<td># Degrees</td>
</tr>
<tr>
<td>Computer Sc.</td>
</tr>
<tr>
<td>Engineering</td>
</tr>
<tr>
<td>Mathematics</td>
</tr>
<tr>
<td>Physical Sc.</td>
</tr>
<tr>
<td>SUB-TOTAL</td>
</tr>
</tbody>
</table>

Source: www.directemployers.org/2012/08/16/the-college-class-of-2013-current-demographics/

US Bachelor's Degrees: 2009-2010

AAC&U–PKAL APPROACH

A very different approach is required for PKAL to do more than the NSF with much less. But the AAC&U brings a different approach:
- focuses just on computer/information science
- focuses on both 2-year and 4-year colleges
- 100,000 increase in CS/IS graduates
- allow course development from any discipline
- focuses on AAC&U learning outcomes.*
  * www.aacu.org/leap/vision.cfm

Computer Science “Dropout” Problem

Left STEM: ~50,000/year
Total Loss: 300,000 in 6 years.
Cutting the yearly loss by a third seems doable

Augsburg’s Proposal

Augsburg’s proposal involves a very different approach to the problem. We argue that it is:
1. Compatible with AAC&U LEAP outcomes
2. Based on $500k W. M. Keck grant
3. Key part field-tested by ~1,000 students
4. Designed to be rapidly scalable.
5. Lead by a seasoned PI.
6. Readily adoptable by 2 & 4 year colleges

Augsburg’s Proposal: Overview

1. Create Data Analytics minor in CS, IS or MIS for Group B (often Social Studies and professions) and Group C (often liberal arts and minorities)
2. Focus: analyzing/presenting information
3. Focus: charts, graphs, Geographic systems
4. Focus: Big Data -- challenges/difficulties
5. Focus: Data analytics using multivariate statistics
6. Use Excel as the computer tool
7. Information Science helps non-profits

STEM Shortage: Underlying Causes

Carnegie (Quantway & Statway) is targeting group D. Augsburg’s proposal is targeting groups B and C.

Percentage of School Seniors taking the ACT who are:

<table>
<thead>
<tr>
<th>Interested in STEM but not proficient in Math</th>
<th>A</th>
<th>Interested in STEM and proficient in Math</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>12%</td>
<td>A</td>
</tr>
<tr>
<td>Not interested in STEM and not proficient in Math</td>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>25%</td>
<td>29%</td>
</tr>
</tbody>
</table>

Source: ACT and Business Higher-Education Forum (BHEF) at www.ncci-cu.org/downloads/BHEF_STEM.pdf
1. Focus on Quantitative Literacy and Excel instead of algebra and calculus.
2. Focus on statistical literacy for analysts instead of traditional research statistics.
3. English is the primary means of describing or comparing statistics instead of Algebra.
4. Induction (practical reasoning) is the primary means of argument instead of deduction.

1. focuses on the role of statistics as evidence in arguments (Quantitative Rhetoric).
2. treats statistics as more like words (influenced by context) than like pure numbers (Platonic).
3. studies where do statistics come from, how were things counted and measured, how were grouped combined, how were measurement categorized, and how statistics are compared and presented.

1. Excel: Logic/Stat, Pivot Tables, Chart/Trend
2. Statistical literacy* or traditional statistics with 15% Statistical Literacy*
3. Data Analytics*, Statistics II (data models*) or Data Communications*.
4. Info Sys. or Decision/Management Science
5. Logic, discrete/finite math or critical thinking
6. One other STEM/quantitative course: c.f., C/S, GIS, Liberal Arts Math, Q/R, Probability

Students recognize that
- Excel is commonly used for analyzing data
- knowing Excel is a valuable job skill
- analyzing data is a valuable job skill
- analyzing data that is real and relevant can be interesting – and even exciting
- data may support more than one right answer
- this minor can complement many majors

Those taking Data Analytics will take more:
- Statistics
- Computer Science/Information Science
- Health Science/Epidemiology

Those taking Data Analytics will have
- a more positive view of STEM majors
- see more value in quantitative reasoning

- Elected member of International Statistical Institute
- world leader in statistical literacy with more than 60 papers. See: Statistical Literacy and Liberal Education at Augsburg College, 2004 Peer Review
- described as “the leader of the statistical literacy movement” by Dr. Joel Best.”
- has developed a unique Statistical Literacy textbook for students in non-quantitative majors.
- is webmaster of www.StatLit.org: largest statistical literacy website (over 180,000 visits in 2013).
Augsburg’s PI: #2
Dr. Milo Schield

• Awarded a $500,000 grant from the W. M. Keck Foundation for “the development of statistical literacy as an interdisciplinary curriculum.”
• Is “chair” of Management Information Systems
• Created the MIS major at Augsburg College
• Has taught courses in Computer Science dept.
• Has taught critical thinking for more than 10 years
• Has developed some unique Excel worksheets that demonstrate abstract statistical ideas and principles.

Augsburg’s PI: #3
Dr. Milo Schield

• Is a leader in using a new online forum, Odyssey, to help students improve their understanding, analysis and expression of abstract ideas.
• Is a leader in providing guides to the use of ordinary English in expressing quantitative relationships – without using algebraic symbols.
• Has designed a unique online tutor that decodes ordinary English descriptions and comparisons and gives students helpful feedback on their mistakes.

Project Goals

1. Offer a Data Analytics minor at Augsburg with a PKAL Data-Analytics Certificate.
2. Completion by at least 15 students per year
3. Embedding PKAL Data-Analytics Certificate
   • in at least a dozen colleges by 2015.
   • In at least 2 dozen colleges by 2016
4. Design web site for adoptee communication
5. Create training materials for decision makers

Dissemination Plans

1. Field test on local faculty (2 & 4 year)
2. Run online faculty development courses
3. Face2Face two-day summer conferences
4. Design web site to disseminate all this.
5. Web videos on Statistical Literacy
6. Web videos on Information Literacy
7. Web videos on Information Science

Augsburg Qualifications

Augsburg is an institution with
• a moderate to low research infrastructure.
• a mainly undergraduate population (2,700 / 3,600)
• a minority serving institution (34% students of color)
• a long-term member of the AAC&U
Although Augsburg has ~ 2,700 undergraduates, Augsburg has pioneered some – and field tested all – of the elements in our proposal including monitoring student success and student satisfaction.

Institutional Team

Dr. Paul C. Pribbenow, President
Dr. Karen Kaivola, Provost
Dr. Amy Gort, Dean of Arts and Sciences
Erica Swift, Director of Sponsored Programs

Dr. Rebekah Dupont, Director STEM Programs
Dr. Kathy Schwalbe, Business/MIS
Marc Isaacson, Business/MIS
Dr. John Schmit, English
Bonnie Tensen, E-Learning Specialist, IT.