Investigating Knowledge and Sources of Scientific Information of University Students and Lifelong Learners

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University of Arizona
25 Year Study of Undergraduates

- In class survey of over 12,000 students from 189-2015
- Mostly freshman and sophomore students with minimal college science experience
- Average science knowledge scores of 75% consistently
- STEM majors do better
- Very little change in answers over 25 years
Students’ Beliefs and Knowledge

<table>
<thead>
<tr>
<th>Factors</th>
<th>Agree ≥ 4 (across factor)</th>
<th>Disagree 2 ≤ (across factor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belief in UFOs or Aliens</td>
<td>Mean = 11.33 (2.27)</td>
<td>Mean = 11.11 (2.36)</td>
</tr>
<tr>
<td></td>
<td>n = 1519</td>
<td>n = 701</td>
</tr>
<tr>
<td>Faith-based Beliefs</td>
<td>Mean = 10.84 (2.30)</td>
<td>Mean = 11.89 (2.22)</td>
</tr>
<tr>
<td></td>
<td>n = 1156</td>
<td>n = 762</td>
</tr>
<tr>
<td>Unscientific Beliefs</td>
<td>Mean = 10.92 (2.32)</td>
<td>Mean = 11.62 (2.32)</td>
</tr>
<tr>
<td></td>
<td>n = 1301</td>
<td>n = 1330</td>
</tr>
</tbody>
</table>

Students’ beliefs and attitudes on scientific issues were not highly correlated with science knowledge. Pseudoscience beliefs are not at odds with functional scientific literacy.
Findings

- Demographic variables accounted for 8% of the variance in students’ science knowledge scores.
  \[ F (4, 9692) = 208.75, \ p < .01, \ R^2_{\text{adj}} = 0.08 \]
  - Strongest single predictor was how many science courses they had completed, yet this only accounted for 3% of the variance in students’ science literacy scores.

- Students’ beliefs and attitudes towards science and technology were related moderately to their science literacy scores and accounted for 40% of the variance in their science literacy scores \( (R^2_{\text{adj}} = 0.039) \).
Study about Sources of Knowledge

- 669 undergraduate students at the University of Arizona
- Enrolled in a non-majors astronomy course between 2013 – 2015
- 48% female, 52% male
- 89% were traditional college aged students (18 – 22 years old)
- Over 75% either freshman or sophomore students
Study about Sources of Knowledge

- 35% business majors, 21% humanities majors, 15% STEM majors (engineering, science and pre med), 15% arts majors and 5% education majors
- 40% had taken two or fewer science courses

<table>
<thead>
<tr>
<th># of college science courses completed</th>
<th>Percent of sample (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>20% (71)</td>
</tr>
<tr>
<td>2</td>
<td>22% (88)</td>
</tr>
<tr>
<td>3</td>
<td>25% (101)</td>
</tr>
<tr>
<td>4</td>
<td>9% (36)</td>
</tr>
<tr>
<td>5</td>
<td>6% (25)</td>
</tr>
<tr>
<td>6 or more</td>
<td>17% (69)</td>
</tr>
</tbody>
</table>
MOOC Learners

- 2889 learners in an online astronomy course offered through Coursera (taught by faculty member at Univ of Arizona)
- 42% female, 58% male
Survey participants from 112 countries

- United States: 1079
- India: 157
- Canada: 148
- United Kingdom: 108
- Spain: 96
- Australia: 82
- Not Specified: 82
- Mexico: 69
- Brazil: 65
- Russia: 55
Variety of Careers

- Student: 19%
- Technical (software,...): 11%
- Unemployed: 11%
- Educator: 9%
- Managerial/business: 9%
- Retired: 8%
- Law/medicine: 8%
- Clerical/administrative: 5%
- Service/retail: 5%
- Work at home: 5%
Education Background

- Middle School: 0%
- Some High School: 2%
- High School: 13%
- Associate Degree: 1%
- Technical Cert./Degree: 1%
- Some College: 18%
- Bachelor's Degree: 33%
- Master's Degree: 24%
- Doctorate Degree: 7%
Individuals with doctorates from 39 countries

The chart shows the number and percentage of individuals with doctorates from 39 countries. The countries are listed on the x-axis, and the number of doctorates is represented by the blue bars. The percentage is shown on the y-axis.

- **US**: 109, 10% of total
- **Spain**: 10, 10%
- **UK**: 10, 10%
- **France**: 7, 7%
- **Canada**: 6, 6%
- **Mexico**: 6, 6%
- **Australia**: 5, 5%
- **Italy**: 4, 4%
- **Brazil**: 3, 3%
- **China**: 3, 3%

The percentage of individuals with doctorates from each country is also indicated, with the following distribution:

- **US**: 10%
- **Spain**: 10%
- **UK**: 9%
- **France**: 15%
- **Canada**: 4%
- **Mexico**: 9%
- **Australia**: 6%
- **Italy**: 15%
- **Brazil**: 5%
- **China**: 7%
Prior College Science Experience

Number of Classes

- None: 26%
- 1 to 4: 35%
- 5 to 9: 14%
- 10+: 24%
MOOC respondents demonstrate more basic science knowledge

- Undergraduate students’ average on science knowledge is 75%
- MOOC students’ average on science knowledge is 88%
  - More accurate and descriptive answers to the prompt, “what does it mean to study something scientifically?”
Motivations to take the course

- Prior interest in astronomy: 82%
- General Curiosity: 63%
- See How Online Education Works: 12%
- Instructor's Reputation: 4%
- Get a Certificate: 7%
- Required by School or Job: 1%
Overall Interest in Science

- Not at all: 6%
- A little Interested: 22%
- Moderately Interested: 38%
- Very Interested: 74%

Comparison between UA and MOOC.
Importance of Science to Career

Very Little/Not at All: UA 45%, MOOC 38%
Somewhat: UA 32%, MOOC 25%
Very: UA 23%, MOOC 37%
<table>
<thead>
<tr>
<th>Students Reported Future Careers</th>
<th>% of respondents who indicated that science is very important to their future career</th>
<th>% of respondents who indicated that science is not at all important to their future career</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undecided (n=156)</td>
<td>16%</td>
<td>46%</td>
</tr>
<tr>
<td>STEM (n=89)</td>
<td>85%</td>
<td>3%</td>
</tr>
<tr>
<td>Business (n=140)</td>
<td>10%</td>
<td>59%</td>
</tr>
<tr>
<td>Service (n=54)</td>
<td>4%</td>
<td>76%</td>
</tr>
<tr>
<td>Public Service (n=81)</td>
<td>17%</td>
<td>37%</td>
</tr>
<tr>
<td>Teachers (n=45)</td>
<td>22%</td>
<td>29%</td>
</tr>
</tbody>
</table>
Where students look for information about science
Where MOOC learners look for information about science

- Google or other Internet Search: 47%
- Science Web Sites (i.e., NASA): 37%
- Online classes like this: 34%
- Wikipedia: 28%
- Professor/Teacher: 22%
- Online paper, magazine, or news site: 14%
- YouTube or other online videos: 13%
- Print paper or magazine: 11%
- Family Member/Friend: 7%
- Blogs: 5%
- Social Media sites (Facebook, etc.): 1%
Undergraduate Students’ Judgement of the Reliability of Information

<table>
<thead>
<tr>
<th>Source</th>
<th>Most Reliable</th>
<th>Least Reliable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professor/Teacher</td>
<td>39%</td>
<td>3%</td>
</tr>
<tr>
<td>Textbooks</td>
<td>46%</td>
<td>2%</td>
</tr>
<tr>
<td>Researchers</td>
<td>34%</td>
<td>2%</td>
</tr>
<tr>
<td>Same info multiple</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Wikipedia</td>
<td>24%</td>
<td>5%</td>
</tr>
<tr>
<td>Science Websites</td>
<td>22%</td>
<td>3%</td>
</tr>
<tr>
<td>Social Media Sites</td>
<td>38%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Legend:
- Violet: Most Reliable
- Light purple: Least Reliable
MOOC Learners’ Judgement of the Reliability of Information

![Bar chart showing the judgment of reliability for different information sources.](chart.png)
What does it mean to study something scientifically?

<table>
<thead>
<tr>
<th>Quality code/sources</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professors/textbooks</td>
<td>20%</td>
<td>37%</td>
<td>38%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Online science sites</td>
<td>11%</td>
<td>42%</td>
<td>37%</td>
<td>11%</td>
<td>0%</td>
</tr>
<tr>
<td>Online searches</td>
<td>37%</td>
<td>48%</td>
<td>16%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

- 76% of the responses coded as a “3” were given by students who reported professors/textbooks as the most reliable sources of information.
Implications

- As instructors, we want to understand where students get information about science.
- Same course for two different populations.
- Continued importance of information literacy
Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant No.1244799. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.