Who Becomes a Physics Major?
Examining the Roles of Pre-college Beliefs about Physics and Learning Physics, Interest, and Academic Achievement

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Are we … Selecting? or Developing? Physics Majors

Selection: Are we simply selecting our majors from a narrowly defined group exhibiting particular characteristics upon entering college?

Development: Are we drawing majors from a broader distribution of students by developing their beliefs about and interest in physics as they become more knowledgeable about physics through their college experience?

Prediction: Is it possible to predict who is likely to become a physics major?

Answers to these questions are important in guiding departmental and national efforts to increase the number and quality of physics majors.

Prior studies suggest selection:
• CLASS scores across introductory and upper-level physics courses have demonstrated correlations between students’ beliefs and their choice of major (1-3).
• Looking across physics courses, Gire et al. [3] found that incoming first-year physics majors (N=15) had expert-like beliefs similar to those of students measured in upper-level courses.

Student Beliefs about Physics and Learning Physics:

Level of Interest:
• Surveys of incoming students in calculus-based physics classes have shown that the typical student has a high level of interest in physics.

Academic Achievement:
• Unlike for beliefs and interests, the grade distribution of intended physics majors is very similar to that of all students.
• Unlike for beliefs and interests, the grade distribution of majors who were originally intended physics majors is also very similar to that of all students.

Who Becomes a Physics Major?
TABLE 1: Students surveyed at START of their 1st college physics course

<table>
<thead>
<tr>
<th>Students in Phys I (Calc-based)</th>
<th>Enrolled</th>
<th>w/pre CLASS</th>
<th>Intended major in physics</th>
<th>Actually majoring in physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp04</td>
<td>583</td>
<td>489</td>
<td>42</td>
<td>12</td>
</tr>
<tr>
<td>Sp05</td>
<td>523</td>
<td>414</td>
<td>13</td>
<td>1</td>
</tr>
<tr>
<td>Fa05</td>
<td>600</td>
<td>389</td>
<td>30</td>
<td>9</td>
</tr>
<tr>
<td>Sp06</td>
<td>534</td>
<td>386</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Fa06</td>
<td>611</td>
<td>495</td>
<td>34</td>
<td>14</td>
</tr>
<tr>
<td>Sp07</td>
<td>566</td>
<td>402</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>All</td>
<td>3417</td>
<td>2575</td>
<td>150</td>
<td>43</td>
</tr>
</tbody>
</table>

TABLE 2: Measures from 1st semester of college physics

<table>
<thead>
<tr>
<th>All students</th>
<th>Intended majors</th>
<th>Actual majors</th>
</tr>
</thead>
<tbody>
<tr>
<td># of students</td>
<td>2800</td>
<td>180</td>
</tr>
<tr>
<td>CLASS Overall Score (Pre)</td>
<td>64.7</td>
<td>73.5</td>
</tr>
<tr>
<td>±0.3</td>
<td>±1.2</td>
<td>±1.4</td>
</tr>
<tr>
<td>Level of interest (Pre)</td>
<td>3.7</td>
<td>4.6</td>
</tr>
<tr>
<td>(1=very low, 5=very high)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Grade</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Avg SAT</td>
<td>1246</td>
<td>1271</td>
</tr>
<tr>
<td>Avg Predicted GPA</td>
<td>3.2</td>
<td>3.1</td>
</tr>
</tbody>
</table>

• Total number of students with other measures available varies for level of interest (N=1808), SAT (N=1891), CLASS Overall Score (N=180), and Predicted GPA (N=1220). *Standard error on the mean shown.

Conclusions and Implications

Answer = Selection (mostly).

Physics Majors come from a select group of students who enter college with expert-like beliefs about physics and high interest, but surprisingly, their grades are typical.

Data provide guidance for efforts to recruit and graduate high-quality physics majors.

1. Reaching out to students with expert-like beliefs and interests in their freshman year.
2. Significant efforts to attract student beliefs and interest in first-year courses.
3. Improving students’ experiences with physics in K-12.

References


Acknowledgements

This work was supported by the CU Science Education Initiative and NSF. We also thank the Physics III instructors and Carl Wieman and the other members of the Physics Education Research at Colorado group.

Development of Physics Majors who were originally intended physics majors (N=52)...

Development of Physics Majors who were originally NOT intended physics majors (N=1280)...

Development of Physics Majors who were actually physics majors (N=1280)...

Development of Physics Majors who were actually NOT physics majors (N=1280)...

Level of Interest

Academic Achievement

Student Beliefs (as measured by CLASS)

Level of Interest

grades are only slightly better than the class as a whole.

TABLE 2: Measures from 1st semester of college physics

Student Beliefs about Physics and Learning Physics:
CLASS survey [1]

Level of Interest:
Currently, what is your level of interest in physics? (very low, low, moderate, high, very high)

Identifying Intended Majors:
What is your current declared major? (selection)
If you plan to change your major, please choose the major you intend to switch to: (selection)

Identifying Actual Majors:
Student records as of November 2009

Academic Achievement:
Course Grades in 1st term of college physics (Phys I or Phys II)
SAT
University-calculated “Predicted GPA” – based on application data

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Sp05 | 523 | 414 | 13 |
Fa05 | 600 | 389 | 30 |
Sp06 | 534 | 386 | 16 |
Fa06 | 611 | 495 | 34 |
Sp07 | 566 | 402 | 15 |
All | 3417 | 2575 | 150 |

TABLE 2: Measures from 1st semester of college physics

All students | Intended majors | Actual majors |
---|---|---|
# of students | 2800 | 180 | 52 |
CLASS Overall Score (Pre) | 64.7 | 73.5 | 78.3 |
Level of interest (Pre) (1=very low, 5=very high) | 3.7 | 4.6 | 4.5 |
Course Grade | 2.7 | 2.7 | 3.0 |
Avg SAT | 1246 | 1271 | 1290 |
Avg Predicted GPA | 3.2 | 3.1 | 3.2 |

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