Assessment Outcomes Report: SEA-PHAGES Program 2015-2016

DAVID I. HANAUER
LEAD ASSESSMENT COORDINATOR OF THE SEA-PHAGES PROGRAM
The Assessment Approach

SEA-PHAGES

Measure psychological states relevant to being involved in a research experience

Relevance to persistence and retention
<table>
<thead>
<tr>
<th>Instrument Name</th>
<th>Feature Measured</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Ownership</td>
<td>Degree of ownership and emotional engagement the student feels over their laboratory research work</td>
<td>Hanauer &amp; Dolan, 2014</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>Degree of student confidence in functioning as a scientist</td>
<td>Estrada, Woodcock, Hernandez, &amp; Wesley Schultz, 2011; Chemers, Zurbriggen, Syed, Goza, &amp; Bearman, 2011</td>
</tr>
<tr>
<td>Science Identity</td>
<td>Degree to which a student thinks about her/himself as a scientist</td>
<td></td>
</tr>
<tr>
<td>Scientific Community Value</td>
<td>Degree of student’s affinity to the values of the scientific community</td>
<td></td>
</tr>
<tr>
<td>Networking</td>
<td>Degree to which a student discusses their research in personal, social and scientific communities</td>
<td>Hanauer &amp; Hatfull, 2015</td>
</tr>
</tbody>
</table>
Persistence in the Sciences (PITS) Survey

- Project Ownership
- Self-Efficacy
- Science Identity
- Scientific Community Values
- Networking
Reporting - The Instructor’s Class Outcomes Report

Figure 1: Persistence in the Sciences Survey: Class Outcome Report

Surveys Completed: 14; Class Participation Rate: 68.8% of total enrollment
Fall, 2015

Mean for 6 Psychological Measures: Class and Program

Figure 2: Percentage of students in your class likely to continue or not continue in the sciences by psychological measures on the PITS survey

Table 1: Frequency, Mean, z-score* and Percentage of Students High, Intermediate and Low Likelihood of Continuing in the Sciences and Threshold Levels

* Each cell is the distance of class mean in standard deviations from the SENGAGE program mean.
<table>
<thead>
<tr>
<th>AIM</th>
<th>Question</th>
</tr>
</thead>
</table>
| PROGRAM ASSESSMENT        | Does the SEA-PHAGES program work?  
• *Is the SEA-PHAGES course significantly different from a traditional laboratory course?*                                                   |
|                           | Does the SEA-PHAGES program work equally well for different genders, ethnicities, GPA levels, types of institution and years of study? |
|                           | Are their differences in the different versions of the SEA-PHAGES program (one semester wet lab; one semester bioinformatics; two semesters Fall/Spring; two semester Spring-summer break– Fall)? |
Does SEA-PHAGES work?

- Is the SEA-PHAGES course significantly different from a traditional laboratory course?
- Comparison of matched groups from random sample (propensity score matching) to isolate the variable of course type (n=117)
- Significantly higher ratings for SEA-PHAGES on all variables except self-efficacy

<table>
<thead>
<tr>
<th></th>
<th>Coef. (Treatment Effect)</th>
<th>Std. Err.</th>
<th>z</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Ownership Content</td>
<td>1.01</td>
<td>.15</td>
<td>6.74</td>
<td>.0001</td>
</tr>
<tr>
<td>Project Ownership Emotion</td>
<td>.96</td>
<td>.2</td>
<td>4.84</td>
<td>.0001</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>.17</td>
<td>.12</td>
<td>1.38</td>
<td>.16</td>
</tr>
<tr>
<td>Science Identity</td>
<td>.31</td>
<td>.15</td>
<td>1.96</td>
<td>.05</td>
</tr>
<tr>
<td>Scientific Community Values</td>
<td>.57</td>
<td>.2</td>
<td>2.74</td>
<td>.006</td>
</tr>
<tr>
<td>Networking</td>
<td>.92</td>
<td>.19</td>
<td>4.84</td>
<td>.0001</td>
</tr>
</tbody>
</table>
Does the SEA-PHAGES program work equally well for men and women?

- Random sample self-identified male and female students n=160

- A non-statistically significant MANOVA effect was obtained, Wilks’ Lambda = .95, F(6, 141) = 1.157, p < .33

- Women do not perform significantly differently from men in the SEA-PHAGES program.
Does the SEA-PHAGES program work equally well for different ethnicities?

- Random sample of self-identified underrepresented (African American and Hispanic Latino) and White and Asian students (n=111)

- A non-statistically significant MANOVA effect was obtained, Wilks’ Lambda = .96, F(6, 104) = .55, p < .77.

- Overall, underrepresented minority and White and Asian students seem to function equally well in the SEA-PHAGES program.
Does the SEA-PHAGES program work equally well for different institution types?

- Random sample of students from 3 institution types (n=103)

- A non-statistically significant MANOVA effect was obtained, Wilks’ Lambda = .91, F(12, 188) = .76, p < .69.

- The different types of institution seem to function equally well in the SEA-PHAGES program.
Does the SEA-PHAGES program work equally well for different GPA levels?

- Random samples three levels of self-reported GPA (2.6-3; 3.1-3.5; 3.6-4) (n=243)

- Significant overall effect:
  Wilks’ Lambda = .88, F (12, 470) = 2.67, p<.002

Post-hoc Analyses – difference situated in mean difference of low and high GPA in relation to Networking

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>F</th>
<th>Partial Eta Squared</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Ownership Content</td>
<td>2</td>
<td>.3</td>
<td>.003</td>
<td>.74</td>
</tr>
<tr>
<td>Project Ownership Emotion</td>
<td>2</td>
<td>2.29</td>
<td>.019</td>
<td>.1</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>2</td>
<td>.55</td>
<td>.005</td>
<td>.57</td>
</tr>
<tr>
<td>Science Identity</td>
<td>2</td>
<td>.76</td>
<td>.006</td>
<td>.47</td>
</tr>
<tr>
<td>Scientific Community Values</td>
<td>2</td>
<td>.89</td>
<td>.007</td>
<td>.41</td>
</tr>
<tr>
<td>Networking</td>
<td>2</td>
<td>6.18</td>
<td>.049</td>
<td>.002</td>
</tr>
</tbody>
</table>
Does the SEA-PHAGES program work equally well for different years of study?

• Random samples of four years of study (Freshman, Sophomore, Junior & Senior) (n=117)

• Significant overall effect:
Wilks’ Lambda = .66, F (18, 330) = 2.69, p<.001.

Post-hoc Analyses – difference situated in mean difference between Freshman and Sophomores/Seniors in relation to Project Ownership and Networking

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>F</th>
<th>Partial Eta Squared</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Ownership Content</td>
<td>3</td>
<td>2.65</td>
<td>.07</td>
<td>.05</td>
</tr>
<tr>
<td>Project Ownership Emotion</td>
<td>3</td>
<td>5.18</td>
<td>.12</td>
<td>.002</td>
</tr>
<tr>
<td>Self-Efficacy</td>
<td>3</td>
<td>.18</td>
<td>.005</td>
<td>.9</td>
</tr>
<tr>
<td>Science Identity</td>
<td>3</td>
<td>1.16</td>
<td>.03</td>
<td>.32</td>
</tr>
<tr>
<td>Scientific Community Values</td>
<td>3</td>
<td>1.66</td>
<td>.04</td>
<td>.18</td>
</tr>
<tr>
<td>Networking</td>
<td>3</td>
<td>6.28</td>
<td>.14</td>
<td>.001</td>
</tr>
</tbody>
</table>
Do the different versions of the SEA-PHAGES program work equally well on the project ownership content variable?

- Random samples of 4 SEA-PHAGES program versions (one semester: wet lab; one semester bioinformatics; two semesters wet lab and bioinformatics fall/spring; two semesters wet lab bioinformatics spring-summer-Fall) and traditional lab (n=601)

- Significant overall effect:
  Wilks’ Lambda = 10.47, F (6, 24) = 2.67, p<.0001
  One way ANOVA: F (4,548) = 41.57, p<.0001

Post-hoc Analyses – difference situated in mean difference between traditional lab and all SEA-PHAGES groups
Do the different versions of the SEA-PHAGES program work equally well on the project ownership emotion variable?

- Random samples of 4 SEA-PHAGES program versions (one semester: wet lab; one semester bioinformatics; two semesters wet lab and bioinformatics fall/spring; two semesters wet lab bioinformatics spring-summer-Fall) and traditional lab (n=601)

- Significant overall effect:
  Wilks’ Lambda = 10.47, F (6, 24) = 2.67, p<.0001
  One way ANOVA: F (4,548) = 30.03, p<.0001

Post-hoc Analyses – difference situated in mean difference between traditional lab and all SEA-PHAGES groups
Do the different versions of the SEA-PHAGES program work equally well on the self-efficacy variable?

- Random samples of 4 SEA-PHAGES program versions (n=601)
- Significant overall effect:
  Wilks’ Lambda = 10.47, F (6, 24) = 2.67, p<.0001
  One way ANOVA: F (4,548) = 6.04, p<.0001
- Post-hoc Analyses – difference situated in mean difference between traditional lab and full course (fall/spring; spring-summer-Fall) & one semester bioinformatics.
Do the different versions of the SEA-PHAGES program work equally well on the science identity variable?

- Random samples of 4 SEA-PHAGES program versions (n=601)
- Significant overall effect:
  Wilks’ Lambda = 10.47, F (6, 24) = 2.67, p<.0001
  One way ANOVA: F (4,548) = 12.44, p<.0001
  Post-hoc Analyses – difference situated in mean difference between traditional lab and all SEA-PHAGES groups
Do the different versions of the SEA-PHAGES program work equally well on the scientific community values variable?

- Random samples of 4 SEA-PHAGES program versions (n=601)
- Significant overall effect:
  Wilks’ Lambda = 10.47, $F(6, 24) = 2.67$, $p<.0001$
  One way ANOVA: $F(4,548) = 32.19$, $p<.0001$
- Post-hoc Analyses – difference situated in mean difference between traditional lab and one semester bioinformatics; one semester wet lab and full course (fall/spring)
- No difference Traditional Lab and Full course with summer break.
Do the different versions of the SEA-PHAGES program work equally well on the networking variable?

- Random samples of 4 SEA-PHAGES program versions (n=601)
- Significant overall effect:
  Wilks’ Lambda = 10.47, F (6, 24) = 2.67, p<.0001
  One way ANOVA: F (4,548) = 6.24, p<.0001
- Post-hoc Analyses – difference situated in mean difference between traditional lab and all SEA-PHAGES groups
SEA-PHAGES Program Conclusions

- On the outcome variables of the PITS survey, the SEA-PHAGES program outperforms the traditional (procedure focused) laboratory course.

- Overall, the SEA-PHAGES program works equally well for men and women, underrepresented minorities, various GPA levels and different types of educational institution making it a scalable approach for improving science education for a wide range of students.

- The SEA-PHAGES program seems to work best in the Freshman year.

- There may be some differences between the versions of the SEA-PHAGES program:
  - Full year (Fall/Spring) performs well for Project Ownership Content, Emotion, Self-Efficacy and Networking.
  - Self-efficacy seems to involve an accumulative effect resulting from two semesters of SEA-PHAGES work.
  - Bioinformatics seem to enhance science identity and scientific community values but involve a drop in emotional responses.
  - The full year regular course (Fall/Spring) outperforms the Full course with a summer break (Spring/Fall) on all variables.
Acknowledgements

• The research presented here was generously funded by the *Howard Hughes Medical Institute*

• My thanks to ALL SEA-PHAGES faculty for helping me to motivate students to participate in the PITS survey data collection process!

• My thanks to David Asai and Graham Hatfull for their continued support of my science educational research, to my co-assessor Mark Graham and to all my colleagues and friends in the SEA-PHAGES program and the Hatfull laboratory at the University of Pittsburgh (Welkin Pope, Dan Russell, Deborah Jacobs-Sera and Crystal Petrone).

THANK YOU
hanauer@pitt.edu
Questions
HANAUER@PITT.EDU