SI2 - Adding Research Accounts to the ASSISTments Platform: Helping Researchers Do Randomized Controlled Studies with Thousands of Students

Worcester Polytechnic Institute

Background on ASSISTments

ASSISTments is a free, university-based platform. Each day, teachers assign problems to thousands of students (currently 30,000 students) through problem sets aligned to the Common Core State Standards. Randomized controlled experiments are often embedded in these problem sets to evaluate the efficacy of learning interventions. Heffernan has been funded by the NSF to conduct certain types of research using ASSISTments (i.e., spacing studies). Seventeen peer-reviewed publications have resulted from controlled experiments conducted within ASSISTments.

Purpose of the SI2 Grant

This grant proposed the evolution of ASSISTments into a shared scientific instrument that researchers could use to experiment with learning at scale. Software infrastructure modifications were necessary to aid in this transformation. The result is the ASSISTments TestBed (www.ASSISTmentsTestbed.org). The community of potential users include educational psychologists and mathematics education researchers. Developing relationships with schools has traditionally been costly for researchers. The ASSISTments TestBed reduces these costs by bridging relationships with teachers and researchers to conduct noninvasive classroom experiments that improve education.

WPIs Contribution

- Created the infrastructure to allow researchers to design and implement their own RCTs
- Created a way for teachers to access materials with embedded RCTs but not be distracted by them.
- Ran multiple trainings (AERA, as well as a webinar) to recruit pilot researchers.
- Created a workflow for idea submission. WPI mentors researchers toward study designs compliant with our IRB via ‘normal instructional strategies.’
- Created the Assessment of Learning Infrastructure (ALI) to provide easy access to study data. This tool cases the data processing and analysis required of researchers as raw data files can be overwhelming.

ASSISTments TestBed Research Progression

1. Establish a Research Idea
   - Develop an intervention to test using the TestBed
   - To use the ASSISTments Subject Pool, submit your idea to our team

2. Design the Study
   - Create a Problem Set in ASSISTments
   - A single Problem Set including all portions of the study is preferable

3. Implement the Study
   - When using the ASSISTments Subject Pool, the problem set will be approved by our team and made accessible to teachers and students

4. Analyze the Data
   - Study approval allows researchers access to both automated and on demand reporting and analysis

5. Report Findings
   - Results should be written up and submit for publication. Further iterations of the work may be conducted (Steps 1-4) prior to publication

Universal Reporting

Dear Researcher,

Welcome to the data record for problem set PSAMR8Z. You have received this record as part of our weekly reporting. Automated data analysis is featured below, offering a preliminary overview of your sample and a selection of analyses for your consideration. The latter portion of this report contains the raw data files from which you can conduct your own thorough analyses. When publishing your work, please reference this report as a stable location for readers to access your data for review and replication.

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Automated Data Analysis

Completion Rates
- Students that have started PSAMR8Z: 1556
- Students that have completed PSAMR8Z: 1043

Bias Assessment

Before analyzing learning outcomes, we suggest first assessing potential bias introduced by your experimental conditions (i.e., examine differential dropout). The table below reports the number of students that have completed PSAMR8Z, split out by experimental condition. Condition distribution was not significantly different, X^2 (2, N = 762) = 4.31, p > 0.05.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>Started</th>
<th>Finished</th>
<th>% Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td>248</td>
<td>144</td>
<td>58</td>
</tr>
<tr>
<td>Video - Human</td>
<td>260</td>
<td>148</td>
<td>57</td>
</tr>
<tr>
<td>Video - Pen</td>
<td>254</td>
<td>126</td>
<td>50</td>
</tr>
</tbody>
</table>

Good Experiences...

- Recruiting was easy. This service is in high demand and we filled our yearly researcher quota in just a single day.
- Researchers love our IRB terms. By separating mentors researchers toward study designs compliant with our IRB via ‘normal instructional strategies.’

Difficulties...

- We spend time negotiating with researchers about what constitutes ‘normal instructional practice’ (researchers want extensive pre/post tests).
- We have pivoted our focus to assignments where completion goals are well known to users, rather than letting researchers design new content that we then had to try to entice teachers to use.
- We have noticed a lack of clear, conceptual assessment items aligned to the Common Core State Standards in our content.

Knowledge Gained

- Pre-registration of studies and hypotheses
- Open data and open materials
- Reductions to the ‘File Drawer’ problem

Success To Date

- Participation from a dozen researchers, representing:
  - Boston College, Freiburg University, Harvard University, Indiana University, Northwestern University, Southern Methodist University, Texas A&M, University of Colorado - Colorado Springs, University of California- Berkeley, University of Maine, University of Wisconsin, and Vanderbilt.
- Participation from an educational company hoping to evaluate their product.
- Publications:
  - The first manuscript resulting from this pool of researchers is in press.
  - Three researchers have published at international conferences.
  - Two manuscripts are in press to promote this ‘research evolution’ in similar learning platforms.

Knowledge gained:

- Skill Builders" are mastery learning based assignments that are accessible to all users
- ALI retrieves and analyzes data each week as sample populations grow

Assessment of Learning Infrastructure

A Tool For Researchers

Raw Data Files

Raw data files contain the logged information for each student that has participated in your study. We provide this data in a variety of formats, as shown below, to assist in your analytic efforts.

- Student Covariate Dataset
- Action Level Dataset
- Problem Level Dataset
- Student Level Dataset
- Student Level + Problem Level Dataset

We encourage you to view our Glossary Page.

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About the Author

Neil T. Heffernan is a Professor of Computer Science, the Director of the Learning Science & Technologies Program, and the creator of ASSISTments.