Teacher-Centered Design:
Improving a K-12 Science Curriculum and its Dashboard
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Introduction
An old argument has reemerged: recent advances in technology have the potential to fundamentally alter how teachers teach, and how students learn. Simultaneously, we have witnessed the growth of a new tech bubble—educational technology—as entrepreneurs, venture and hedge funds, and philanthropists rush to create the latest and greatest tool (Cavanagh, 2013; Davis, 2013). There are still major barriers that limit technology’s potential impact on K-12 classrooms:

- Teacher technology content knowledge
- Teacher beliefs and attitudes
- Time
- Access to technology

Technology design: “Tools risk being at best underused and at worst irrelevant if educational technology designers do not take into account the needs of educators and how they adapt technology to meet their local needs” (Cho & Wayman, in press; Means, Padilla, DeBarger, & Bakia, 2009).

Objectives
This study had two objectives:
1. To uncover how teachers use, perceive their use, and feel about one specific K-12 science curriculum program and data dashboard
2. To document and discuss the roles of master science teachers in revising and improving the curriculum and dashboard

Literature Review
Technology in education: Can edtech live up to its hype?
- Benefits are contingent on how technologies are used
- Barriers to use:
  - Time to integrate technology
  - Training and knowledge about technology
  - Access to technology in and out of the classroom
- End users and edtech designers are not always on the same page
  Intended vs. actual use—sensemaking (Weick, 1995; Coburn, 2001; Datnow, 2006; Palmer & Snodgrass Rangel, 2011) and interpretive flexibility (Cho & Wayman, in press)
- Where does that leave us?
  Design-based research (Barab & Squire, 2004; Cobb, diSessa, Lehrer, & Schaeuble, 2003)

Research Questions
1. How do X-STEM teachers report using the curriculum and dashboard?
   a. Does reported use align with actual use?
   b. Do reported and actual use align with intended use, as articulated by the curriculum designers?
2. What are X-STEM teachers’ attitudes about the curriculum and dashboard?
   a. Do these attitudes differ from teachers who use different science curricula?
   b. Do different attitudes correlate to different levels and/or patterns of use?
3. What role do teachers play in revising the X-STEM curriculum and dashboard?
   a. What changes and improvements were recommended?
   b. Do their participation affect their attitudes toward the curriculum and dashboard?

Methods
Quantitative:
- Survey analysis
  
<table>
<thead>
<tr>
<th>Curriculum</th>
<th>n</th>
<th>Response rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-STEM</td>
<td>210</td>
<td>29%</td>
</tr>
<tr>
<td>non-X-STEM</td>
<td>103</td>
<td>14%</td>
</tr>
</tbody>
</table>
- Analytics analysis
  Correlations between three reported use variables and four actual use variables
  Correlations between teachers’ reported use of the curriculum in its intended sequence and its actual sequence of use
  Independent samples t-tests to determine if X-STEM and non-X-STEM teachers varied in their survey responses

Qualitative:
- Focus group and questionnaire with 17 master elementary science teachers
- Follow-up interviews with four of the master teachers
  - Describing and categorizing teachers’ responses to the questionnaire and during the focus group
  - Describing and categorizing responses during follow-up interviews

Results
Research Question 1a and 1b:
- Teachers reported using X-STEM for some to most of the objectives they taught. However, there was much more variability in actual use according to the data analytics.

Research Question 2a:

<table>
<thead>
<tr>
<th></th>
<th>non-X-STEM teachers</th>
<th>X-STEM Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology in the classroom</td>
<td>2.46</td>
<td>2.24</td>
</tr>
<tr>
<td>Attitude toward science</td>
<td>3.42</td>
<td>3.31</td>
</tr>
<tr>
<td>Attitude toward technology</td>
<td>3.24</td>
<td>3.31</td>
</tr>
<tr>
<td>District common understanding</td>
<td>2.90</td>
<td>2.95</td>
</tr>
<tr>
<td>Support for teaching science</td>
<td>2.27</td>
<td>2.60*</td>
</tr>
<tr>
<td>Science in your school</td>
<td>2.69</td>
<td>2.82</td>
</tr>
<tr>
<td>How often teachers access</td>
<td>2.03</td>
<td>4.11*</td>
</tr>
<tr>
<td>curriculum website</td>
<td>2.58</td>
<td>3.22*</td>
</tr>
<tr>
<td>Attitudes toward science</td>
<td>2.93</td>
<td>2.98*</td>
</tr>
<tr>
<td>Attitude toward curriculum</td>
<td>2.53</td>
<td>2.98**</td>
</tr>
</tbody>
</table>

Note: The range of responses for Technology in the classroom and Attitude to science are 1-5 and for attitude and support are 1-4 with higher scores indicating more positive attitudes. *p < .05

Research Question 2b:
- No significant correlations between teachers’ attitudes toward science and technology and their reported or actual use of X-STEM.
- Teachers who had more positive attitudes about X-STEM and the X-STEM dashboard reported more frequent use of the curriculum and visited the SE components more frequently, although these correlations were small.

Discussion
- By harnessing the power of learning analytics, the study employed a relatively new technique that has tremendous potential for learning about technology use.
- The gap between teacher’s reported use of the curriculum and their actual use echoes existing findings that teachers’ beliefs and perceptions often are disconnected from their actual behaviors.
- While teacher training on a new technology may be necessary, it is not sufficient for ensuring ‘good’ use of the tool.
- Technology and curriculum designers need to embrace the reality of flexibility by ensuring their products are not so rigid that they will only work if implemented as intended.
- While technology might have the potential to revolutionize and ‘disrupt’ education, any change is contingent on how the technology is (or is not) integrated into the daily work of school.

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Embedded Resources
- Common understanding
- Support for teaching science
- Science in your school
- How often teachers access curriculum website
- Attitudes toward science
- Attitude toward curriculum dashboard