inBloom

Learning Map and inBloom Index System

Data Model and Server

Exemplary Visualizations **Developer Guide**

22 Jan 2013

Applied Minds, LLC

1209 Grand Central Ave Glendale CA 91201

Contents

Background

The Learning Map Data Model

The Bill & Melinda Gates Foundation (the Foundation) supports the implementation of the Common Core State Standards for US K-12 education. The Foundation awarded a contract to Applied Minds, LLC (AMI) to develop a Learning Map Data Model (LMDM) with the goal of it becoming a standard for educational technology infrastructure. The Learning Map will provide the organizing framework that maps the relationship between learning objectives, including dependencies and higher level groupings. It will also allow educational media resources, such as courses, books and web content to be linked to learning objectives. Curricula aligned to the standards will exhibit great diversity in highlighting paths through the Learning Map, and a suite of tools will allow authoring and visualization of the Learning Map. We believe that this data model will eventually enable the creation of online learning tools that are more responsive to the individual needs of a student. The LMDM is inspired by and based on the philosophy of the more general Knowledge Web (See: http://edge.org/conversation/aristotle-the-knowledge-web).

inBloom Technology

The Foundation has, in collaboration with the Carnegie Corporation, initiated an ambitious effort, Shared Learning Infrastructure (SLI), now inBloom Technology, to provide a new technology infrastructure that supports the Common Core Standards and the Foundation's vision, to be implemented by inBloom. AMI has been contracted by inBloom to build an implementation of a Learning Map and Learning Registry System, suitable for third-party software developers to populate content and develop applications.

Exemplary Visualizations

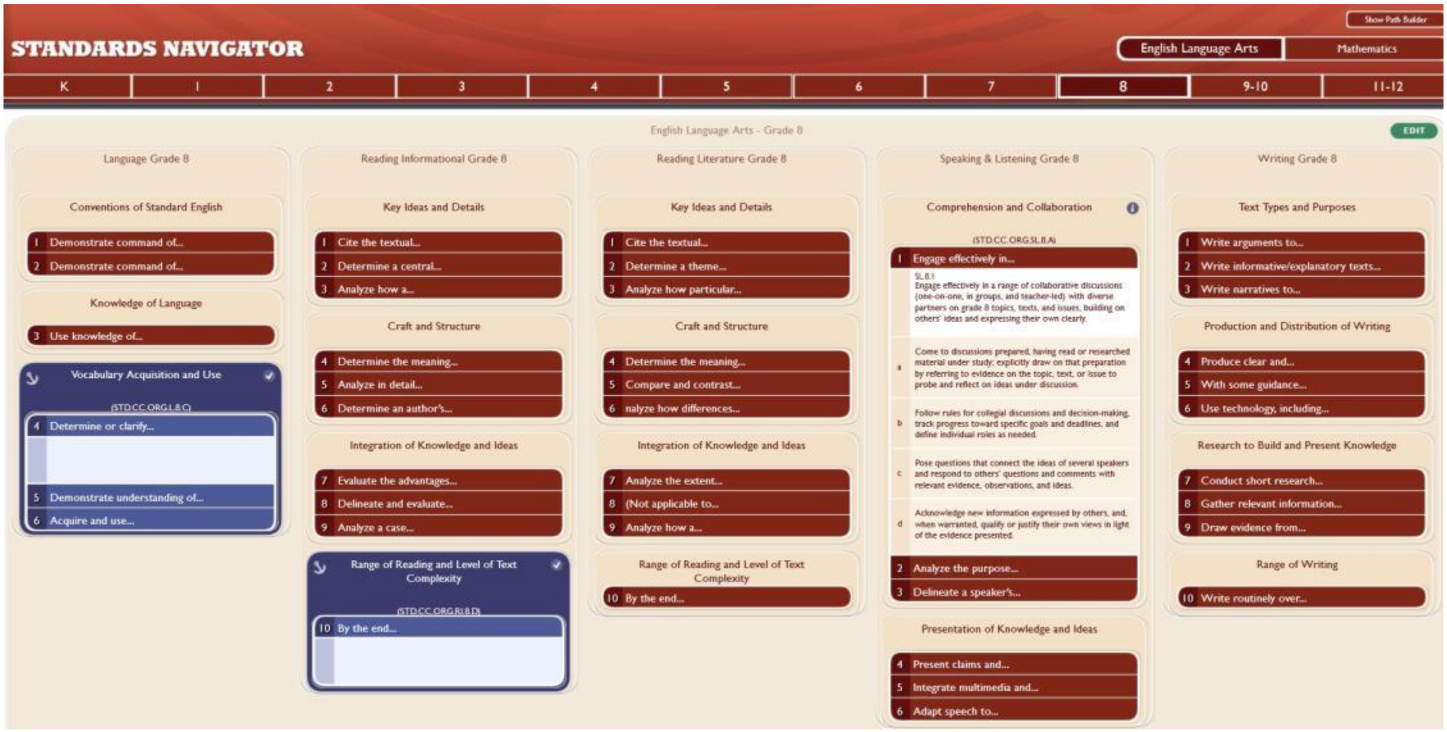
As part of this effort, AMI has delivered several Exemplary Visualizations. These are intended to showcase the capabilities of the inBloom Index data model and server, and to provide a reference for third-party software developers as they begin to build innovative applications using the inBloom Infrastructure.

This document provides an overview and some usage notes on the various Exemplary Visualizations and tools delivered by AMI:

1. Standards Browser
2. Standards Authoring Tool
3. Path Builder Tool
4. "Treasure Map" Path Visualization Tool
5. "Abstract Map" Path Visualization Tool
6. Interactive Path Builder and Visualization Tool

Standards Browser

The Standards Browser provides a simple and elegant user interface to the Common Core State Standards, as well as other standards that may be in the inBloom Index or created by users using the Standards Authoring Tool.



English Language Arts - Grade 8

Language Grade 8

Conventions of Standard English
1 Demonstrate command of...
2 Demonstrate command of...

Knowledge of Language
3 Use knowledge of...

Vocabulary Acquisition and Use
(STD.CC.ORG.L.8.C)
4 Determine or clarify...
5 Demonstrate understanding of...
6 Acquire and use...

Reading Informational Grade 8

Key Ideas and Details
1 Cite the textual...
2 Determine a central...
3 Analyze how a...

Craft and Structure
4 Determine the meaning...
5 Analyze in detail...
6 Determine an author's...

Integration of Knowledge and Ideas
7 Evaluate the advantages...
8 Delineate and evaluate...
9 Analyze a case...

Range of Reading and Level of Text Complexity
(STD.CC.ORG.RI.8.D)
10 By the end...

Reading Literature Grade 8

Key Ideas and Details
1 Cite the textual...
2 Determine a theme...
3 Analyze how particular...

Craft and Structure
4 Determine the meaning...
5 Compare and contrast...
6 nalyze how differences...

Integration of Knowledge and Ideas
7 Analyze the extent...
8 (Not applicable to...
9 Analyze how a...

Range of Reading and Level of Text Complexity
10 By the end...

Speaking & Listening Grade 8

Comprehension and Collaboration
(STD.CC.ORG.SL.8.A)
1 Engage effectively in...

SL.8.1
Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

a Come to discussions prepared, having read or researched material under study; explicitly draw on that preparation by referring to evidence on the topic, text, or issue to probe and reflect on ideas under discussion.

b Follow rules for collegial discussions and decision-making, track progress toward specific goals and deadlines, and define individual roles as needed.

c Pose questions that connect the ideas of several speakers and respond to others' questions and comments with relevant evidence, observations, and ideas.

d Acknowledge new information expressed by others, and, when warranted, qualify or justify their own views in light of the evidence presented.

2 Analyze the purpose...
3 Delineate a speaker's...

Presentation of Knowledge and Ideas
4 Present claims and...
5 Integrate multimedia and...
6 Adapt speech to...

Writing Grade 8

Text Types and Purposes
1 Write arguments to...
2 Write informative/explanatory texts...
3 Write narratives to...

Production and Distribution of Writing
4 Produce clear and...
5 With some guidance...
6 Use technology, including...

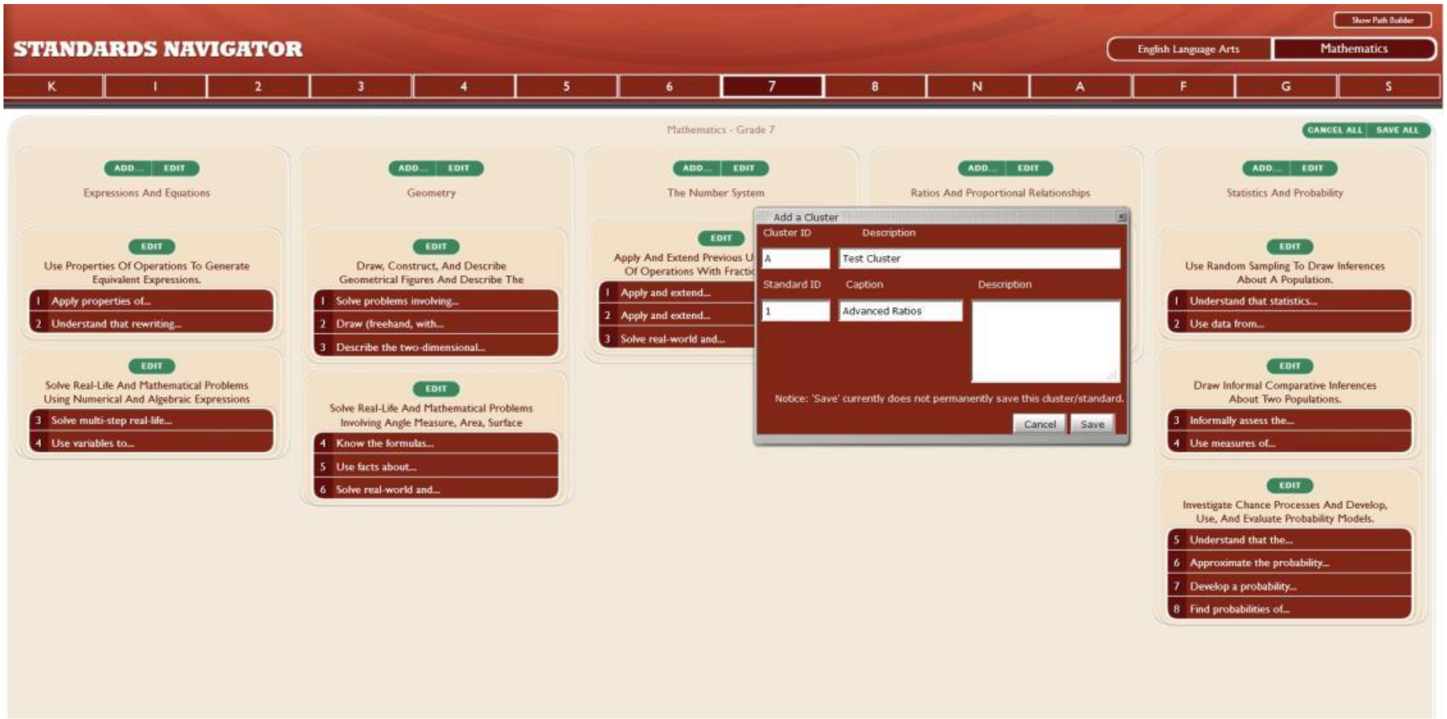
Research to Build and Present Knowledge
7 Conduct short research...
8 Gather relevant information...
9 Draw evidence from...

Range of Writing
10 Write routinely over...

Figure 1. Standards Browser, showing Common Core State Standards and Anchor Standards.

Standards Authoring Tool

Integrated into the Standards Browser is a Standards Authoring Tool. This allows users to edit existing standards, add standards to an existing Specification (such as the Common Core State Standards), and even to create an entirely new Standards Specification from scratch.



Mathematics - Grade 7

Expressions And Equations

Use Properties Of Operations To Generate Equivalent Expressions.

1 Apply properties of...
2 Understand that rewriting...

Solve Real-Life And Mathematical Problems Using Numerical And Algebraic Expressions

3 Solve multi-step real-life...
4 Use variables to...

Geometry

Draw, Construct, And Describe Geometrical Figures And Describe The

1 Solve problems involving...
2 Draw (freehand, with...
3 Describe the two-dimensional...

Solve Real-Life And Mathematical Problems Involving Angle Measure, Area, Surface

4 Know the formulas...
5 Use facts about...
6 Solve real-world and...

The Number System

Apply And Extend Previous U Of Operations With Fractic

1 Apply and extend...
2 Apply and extend...
3 Solve real-world and...

Ratios And Proportional Relationships

Add a Cluster

Cluster ID: A
Description: Test Cluster
Standard ID: 1
Caption: Advanced Ratios
Description:

Notice: 'Save' currently does not permanently save this cluster/standard.

Statistics And Probability

Use Random Sampling To Draw Inferences About A Population.

1 Understand that statistics...
2 Use data from...

Draw Informal Comparative Inferences About Two Populations.

3 Informally assess the...
4 Use measures of...

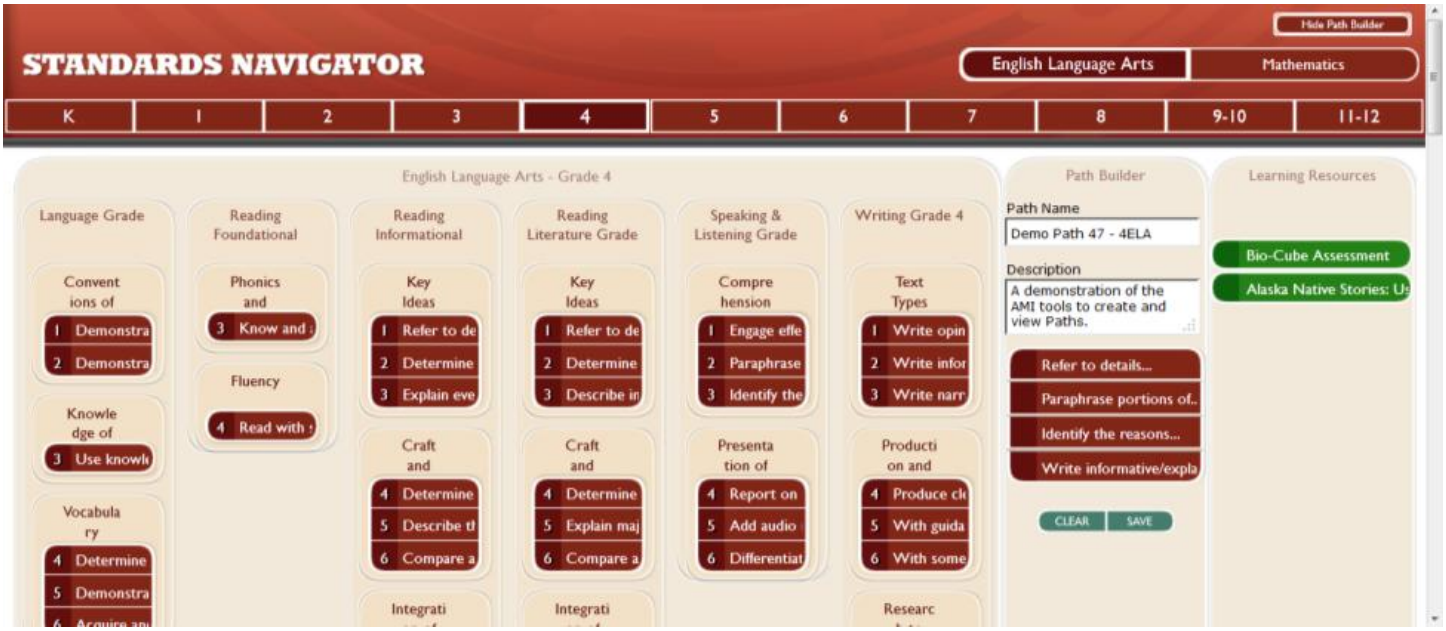
Investigate Chance Processes And Develop, Use, And Evaluate Probability Models.

5 Understand that the...
6 Approximate the probability...
7 Develop a probability...
8 Find probabilities of...

Figure 2. Standards Authoring Tool used to add an individual standard to an existing specification.

Path Builder Tool

The Path Builder Tool is also integrated into the Standards Browser. This allows users to drag and drop individual standards into a Path (on the right of the screen in Figure 3). This list of standards (or Competencies in the language of the data model) is a Path that may be recommended to students to achieve a certain desired Competency. As a teacher or other user builds the Path, Learning Resources that are aligned to the standard they add to the Path will be displayed (in green below).



Path Name
Demo Path 47 - 4ELA

Description
A demonstration of the AMI tools to create and view Paths.

Refer to details...
Paraphrase portions of..
Identify the reasons...
Write informative/expla

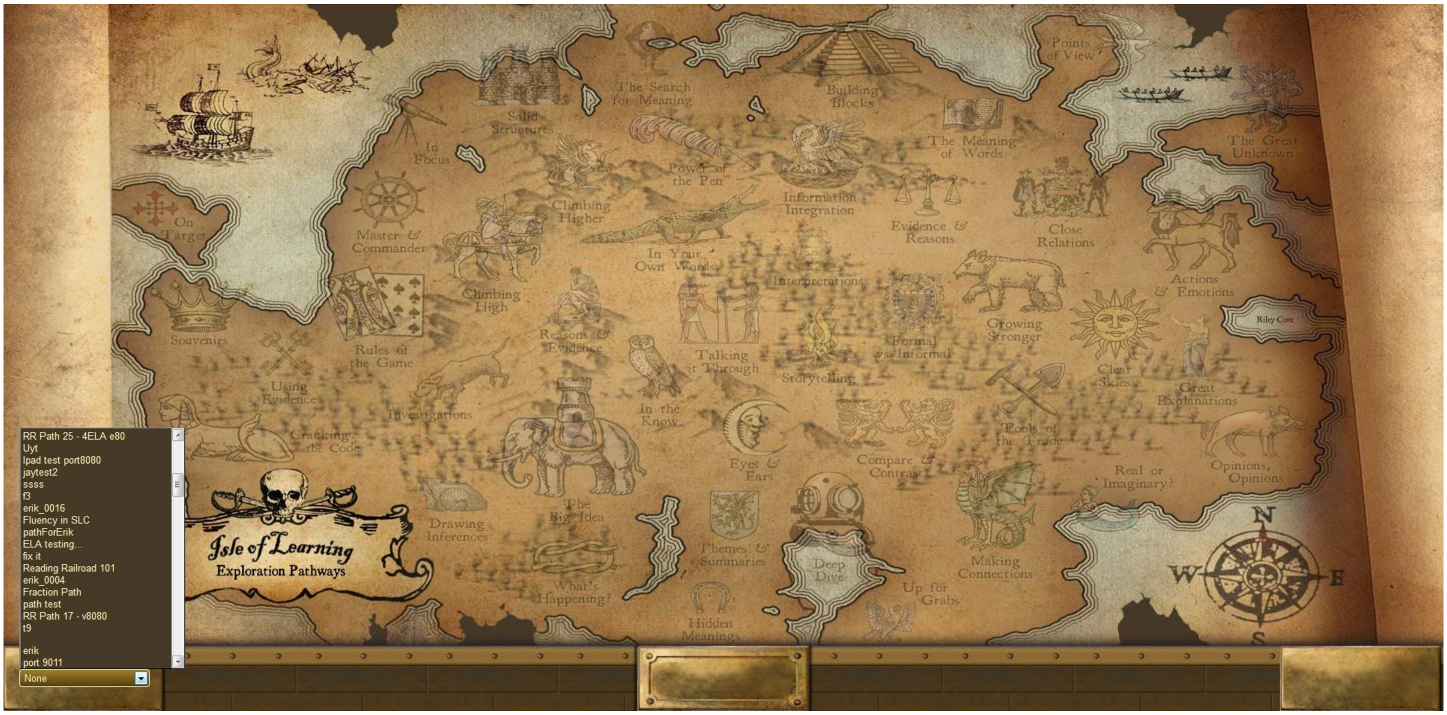
Bio-Cube Assessment
Alaska Native Stories: Us

Figure 3. Path Builder Tool screenshot. As Competencies are dragged into the Path list, aligned Learning Resources are displayed (right).

"Treasure Map" Path Visualization Tool

The inBloom Index Technology is built to encourage a diverse set of end-user applications from the utilitarian to the whimsical. The Paths that have been created by teachers (either by using the Path Builder Tool or other tools) are intended to be viewed and made use of by students.

For fourth-grade ELA students, AMI came up with the concept of showing the set of Competencies to be learned as areas on a map, and the Paths connecting them as ways of exploring a Treasure Island. This "Treasure Map" visualization communicates the power of Paths, allows us to showcase the API to the inBloom Index Server, and demonstrates the need for diverse solutions to Path visualization.



```
RR Path 25 - 4ELA e80
Uyt
Ipad test port8080
jaytest2
ssss
f3
erik_0016
Fluency in SLC
pathForErik
ELA testing...
fix it
Reading Railroad 101
erik_0004
Fraction Path
path test
RR Path 17 - v8080
t9

erik
port 9011
None
```

Figure 4. A Path may be selected from a list with the Treasure Map Exemplary Visualization tool.

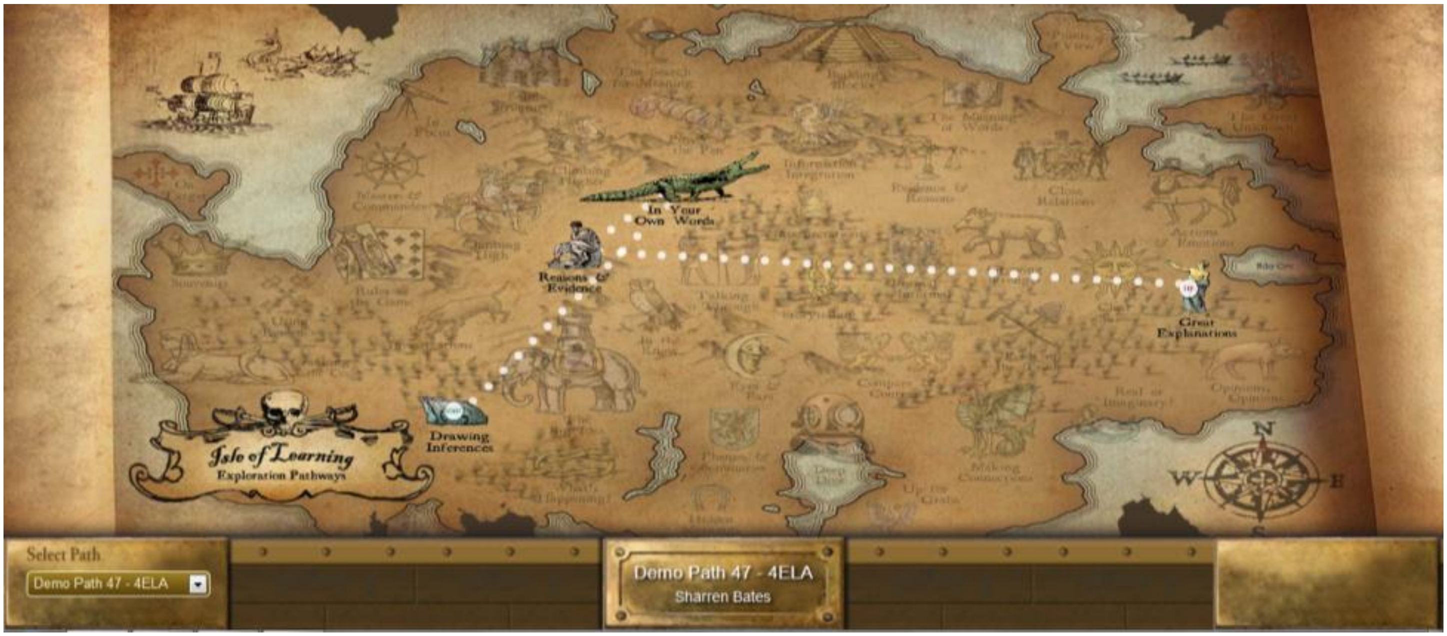
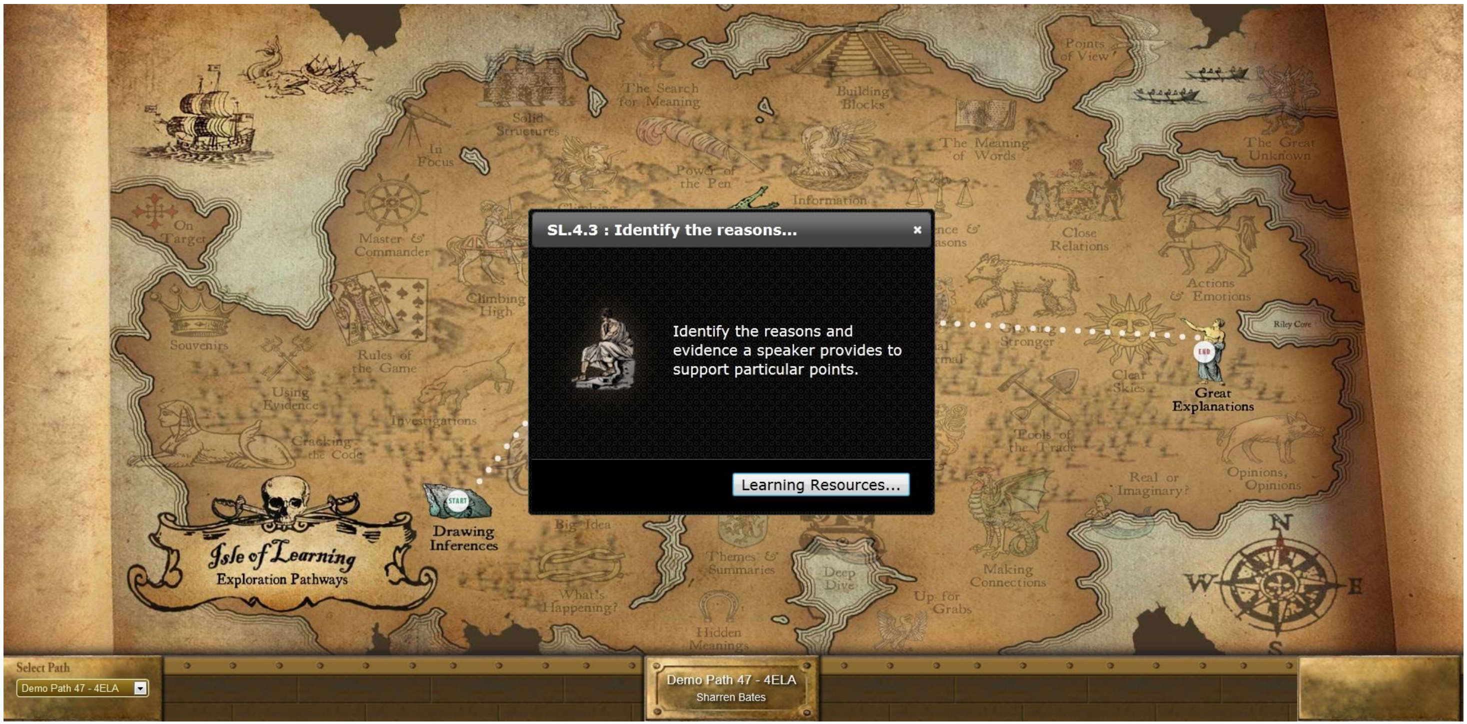


Figure 5. A Path is visualized using the Treasure Map Exemplary Visualization tool.


SL.4.3 : Identify the reasons...

Identify the reasons and evidence a speaker provides to support particular points.

Figure 6. Clicking on an individual Competency brings up more details, and links to aligned Learning Resources.

Skinning the Treasure Map

This document outlines the steps required to create custom skins for the Treasure Map (TM) application. The Treasure Map is an HTML application that facilitates the visualization of "paths" created using the Path Editor. The Treasure Map is architected so that administrators can readily define their own “skins” and thus add to the default “Treasure Map” and “Abstract” skins that ship with the application.

Folder Structure

There are two folders of interest regarding skins:

- TreasureMap/data contains the *skins.json* configuration file
- TreasureMap/skins contains skin-specific coordinates and images

Configuration File

The skin configuration file "TreasureMap/data/skins.json" contains the following data entries:

```
{
  "data" : {
    "skin" : [
      {
        "id" : "s000",
        "name" : "Abstract Map",
        "directory_name" : "abstract",
        "theme" : "Dark Hive",
        "draw_mode" : "code",
        "author" : "Applied Minds"
      },
      {
        "id" : "s001",
        "name" : "Treasure Map",
        "directory_name" : "treasure_map",
        "theme" : "Swanky Purse",
        "draw_mode" : "skin",
        "author" : "Applied Minds"
      },
      {
        "id" : "s002",
        "name" : "Default Template",
        "directory_name" : "default",
        "theme" : "Dark Hive",
        "draw_mode" : "skin",
        "author" : "Shared Learning Collaborative"
      }
    ]
  }
}
```

- id: unique identifier; can be any unique string, sequential naming recommended ("s003")
- name: appears in the browser title bar; can be any string description; does not need to be unique
- directory_name: needs to match an actual folder name within the TreasureMap/skins directory
- theme: the jQueryUI theme; the map ships with two themes: "Swanky Purse" and "Dark Hive"
- draw_mode: should always be "skin" (except for abstract map, which specifies "code")
- author: person or entity that created the skin; does not need to be unique

Adding a new custom skin requires appending a new entry to this file, which requires a knowledge of JSON. Note that the three existing entries in the file should not be altered in any way.

Skin Files

The skins files reside in the TreasureMap/skins directory, which is structured as follows:

```
directory_name
        css
        data
                images_captions.json
                images_icons.json
        images
                icons
                        ico_default.png
                        ico_footstep.png
                        ico_path_end.png
                        ico_path_start.png
                        txt_default.png
                ui
                        bg_end_plate_left.png
                        bg_end_plate_right.png
                        bg_main.jpg
                        bg_name_plate.png
                        bg_plank.png
```

images_icons.json

The *images_icons.json* file handles the display of ccid-related icons and specifies the following parameters:

- name: the image filename (e.g., ico_compare-contrast.png)
- ccid: the unique ccid that links this icon to the Common Core (e.g., RF.4.3)
- size: the width and height size parameters of the image
- position: the x and y position parameters of the image

images_captions.json

The *images_captions.json* file handles the display of ccid-related captions and specifies the following parameters:

- name: the image filename (e.g., txt_compare-contrast.png)
- ccid: the unique ccid that links this image to the Common Core (e.g., RF.4.3)
- size: the width and height size parameters of the image
- position: the x and y position parameters of the image

To afford flexibility in layout, the current skin implementation accommodates icons and captions residing in separate files. If easier from an art-creation perspective, it is also possible to merge icons and captions into a single image file and then use only the data from *images_icons.json*.

Note: for an icon to appear on the map, the ccid parameter must match exactly one that exists in the saved path.

images/icons folder

The images/icons folder contains the images referred to in *images_icons.json* and *images_captions.json*, including:

- ico_default.png the default icon for the map
- ico_footstep.png the "footstep" icon showing the dots connecting two path nodes
- ico_path_end.png the last icon displayed on the path
- ico_path_start.png the first icon displayed on the path
- txt_default.png the default label used on the map (not used in abstract map)

For optimum results, images should be saved in the 24-bit "png" format, with alpha-channel transparency. Other image formats (e.g., jpg and gif) may be used as well, although transparency offers more flexibility in layout. The key requirement is that the filename must match exactly those specified in *images_icons.json* and *images_captions.json*.

images/ui folder

The images/ui folder contains the background images for the skin, including:

- bg_end_plate_left.png the background image for the left plate
- bg_end_plate_right.png the background image for the left plate
- bg_main.jpg the main background image for the skin
- bg_name_plate.png the background image for the center plate

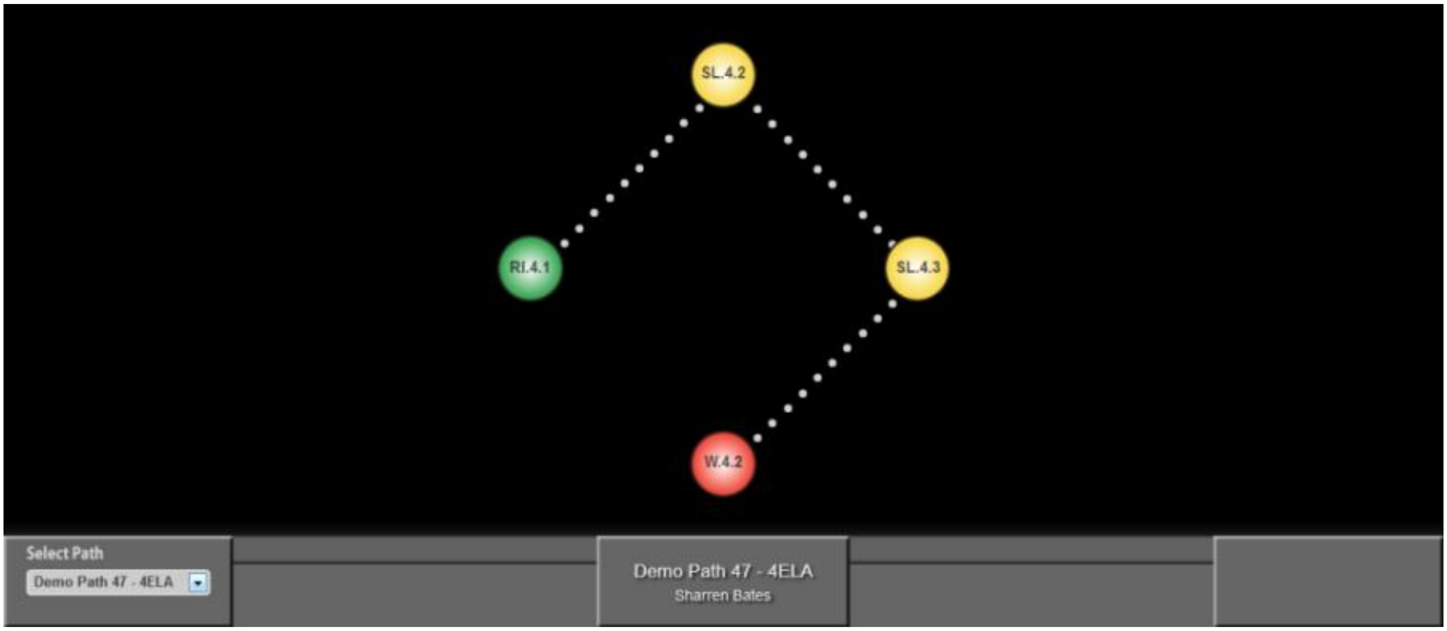
► bg_plank.png	the repeatable background image for the spaces between the plates

In addition to appending an entry in the *skins.json* file as described on the previous page, adding a new skin requires duplicating the "default" folder and replacing the JSON and image files with your own.

“Abstract Map” Path Visualization Tool

inBloom requested a more general Path Visualization than the Treasure Map, which has a particular graphical theme and a very specific subject and grade focus. AMI agreed, and created the Abstract Map tool by modifying the Treasure Map codebase.

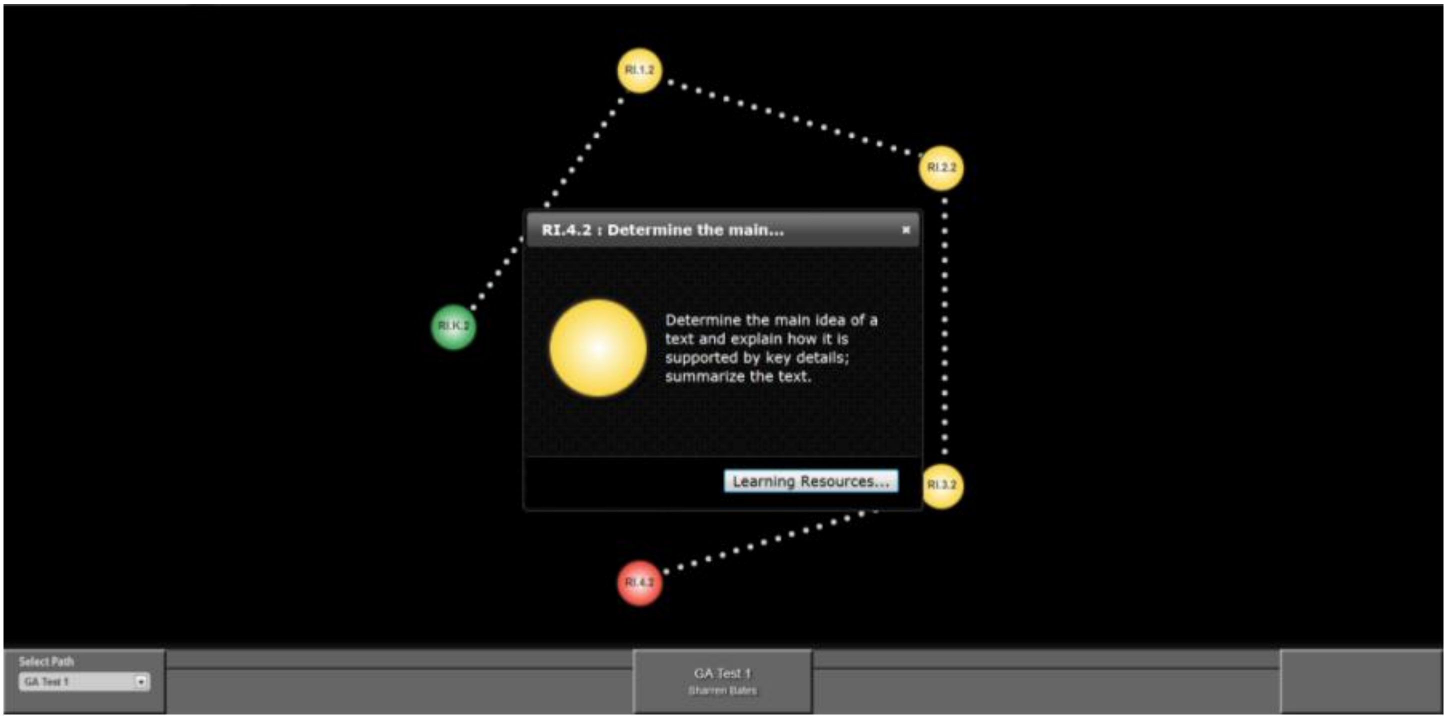
The Abstract Map tool is used in the same manner as the Treasure Map tool but uses a different graphical theme.



Select Path
Demo Path 47 - 4ELA

Demo Path 47 - 4ELA
Sharren Bates

Figure 7. The Path shown in Figure 5 is visualized here using the Abstract Map Exemplary Visualization tool.



Determine the main idea of a text and explain how it is supported by key details; summarize the text.

Figure 8. Demo Path "GA Test 1" as visualized using the Abstract Map Exemplary Visualization tool.

Interactive Path Builder and Visualization Tool

Introduction

One of the goals of the AMI effort was to show how a powerful and flexible technology infrastructure could inspire a variety of end-user applications and could support quick development of such applications.

To illustrate this, members of the AMI team explored the use of D3, a library for data manipulation that has features for visualizations of nodes and links in a graph, and built an application that used it for the inBloom Index. We chose D3 for the Path Builder for its data-binding and support for JSON; for its force-directed layout which lets us easily represent and manipulate Competency Paths; and for its wealth of examples.

The Interactive Path Builder (IPB) is used to make and visualize Competency Paths through the Common Core State Standards and custom Standards created by the Authoring Tool and other fashions. Paths are "AND" Paths -- Path Steps can have multiple Standards, all of which must be completed before moving on to the next Step. The IPB saves new Paths to the inBloom Index and loads existing paths from it.

Menus

Three sets of menus are provided for looking up Standards in the inBloom Index. From top to bottom each menu represents a lower level in the hierarchy. A selection from one menu triggers an inBloom Index query that populates the next menu in the hierarchy. At the lowest level are Standards that can be added to a Path.

The menus are:

- Framework CCSS.ELA-Literacy: For querying the inBloom Index for Common Core ELA Standards.
- Set CCSS.Math.Content: For querying the inBloom Index for Common Core Math Standards.
- Custom: For querying the inBloom Index for Custom Standards.

Clicking "Add standard" places the selected Standard on the current Path Step. A Path Step can have any number of attached Standards.

Viewer

Displays Path Steps and Competencies in a graph with large nodes representing Path Steps and smaller nodes representing competencies. Path Steps are numbered starting with 0 to indicate order.

Toolbar

- Add node button: Click to add new step node to the graph. This node becomes the current Path Step. Standard nodes added to the graph are connected to this node.
- "Enter path name" input: Type the name of the Path Here.
- "Enter author name": Type your name here.
- Save path ...: Click to save the Path to the LRI. Disables edits.
- Clear path: Discards the current Path.
- Pick a path: Select a Path to load from the LRI and display it.

Making a New Path

- Select a Standard from a menu
- Click Add standard
- Enter Path name
- Enter Author name
- Click Save path

Loading an Existing Path

To load a Path from the LRI select it from the "Pick a path" menu. Loading a Path presents the Path for viewing only and disables edits.

Technology

Javascript, jQuery, D3, LRI, LRI Middleware