

Towards ITS Authoring Tools for Domain Experts

Robert Taylor

Andy Smith

Bradford Mott

Samuel Leeman-Munk

James Lester

Department of Computer Science
North Carolina State University



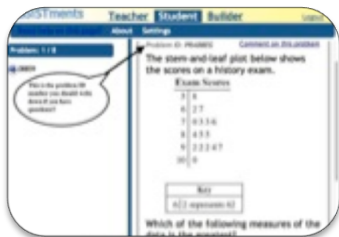
the **intelliMEDIA**
group



Authors



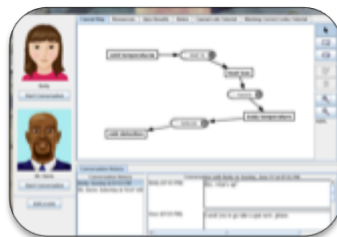
Authoring Tools



Assistments



AutoTutor



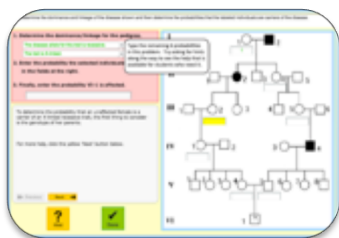
Betty's Brain



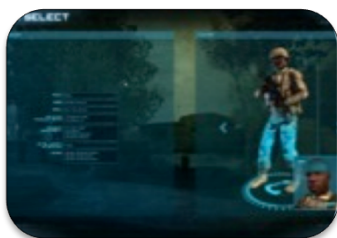
Bio-World



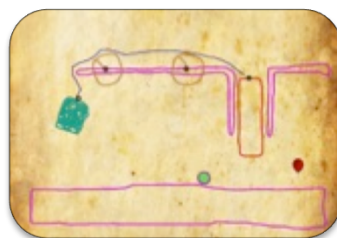
Crystal Island



Genetics Tutor



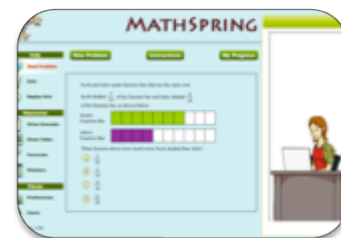
GIFT - vMedic



Physics Playground



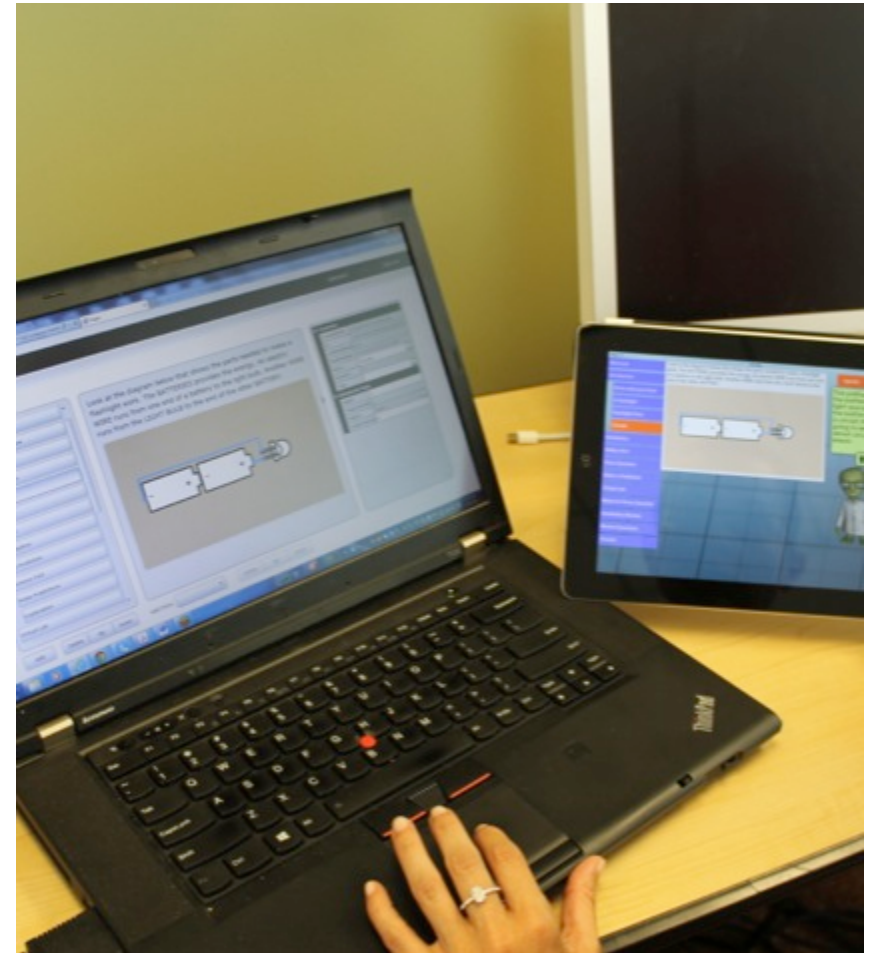
Virtual Cultural Awareness Trainer



Wayang Math Tutor

Challenges of ITS Authoring

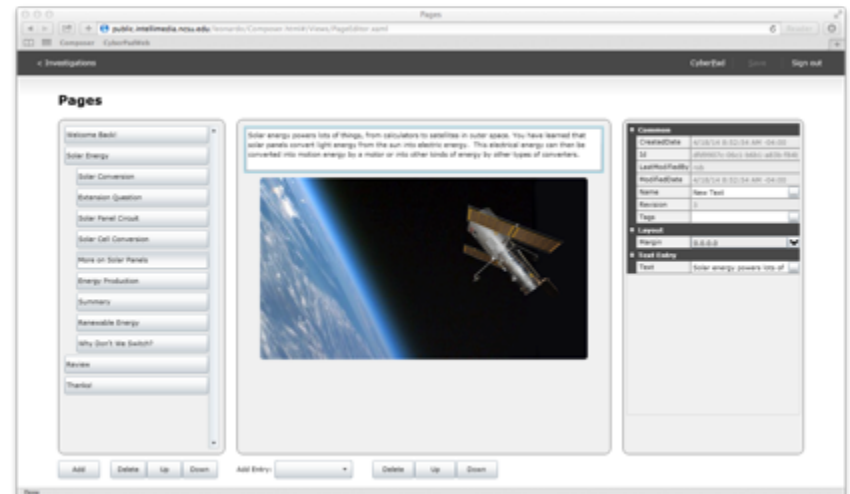
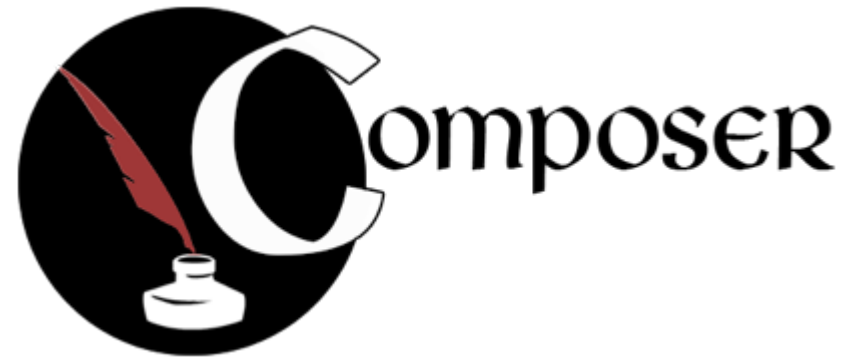
- Authors who are not ITS experts
- Enabling collaboration
- Reducing the ITS complexity exposed to the author



Design Principles for ITS Authoring Tools



- Design principles derived from our experience
- Adopting existing UI and workflows
- Leveraging software engineering techniques



Outline



- Related Work
- Case Study: Authoring the LEONARDO Digital Science Notebook
- Design Principles for ITS Authoring Tools
- Conclusion and Future Work

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- **Related Work**
- Case Study: Authoring the LEONARDO Digital Science Notebook
- Design Principles for ITS Authoring Tools
- Conclusion and Future Work

Related Work

Eon [Murray 1997] is an authoring tool prototype for specifying:

- Learning environment
- Domain knowledge
- Teaching Strategies
- Student Model

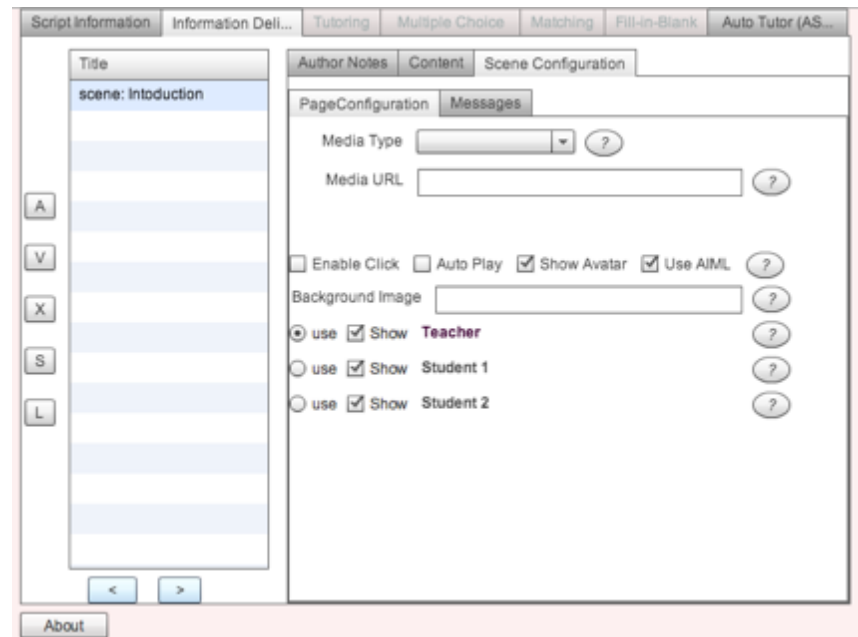


Eon

Related Work

ASAT [Graesser 2005] is used to build AutoTutor-based tutors:

- Conversation scripts
- Content
- Production rules

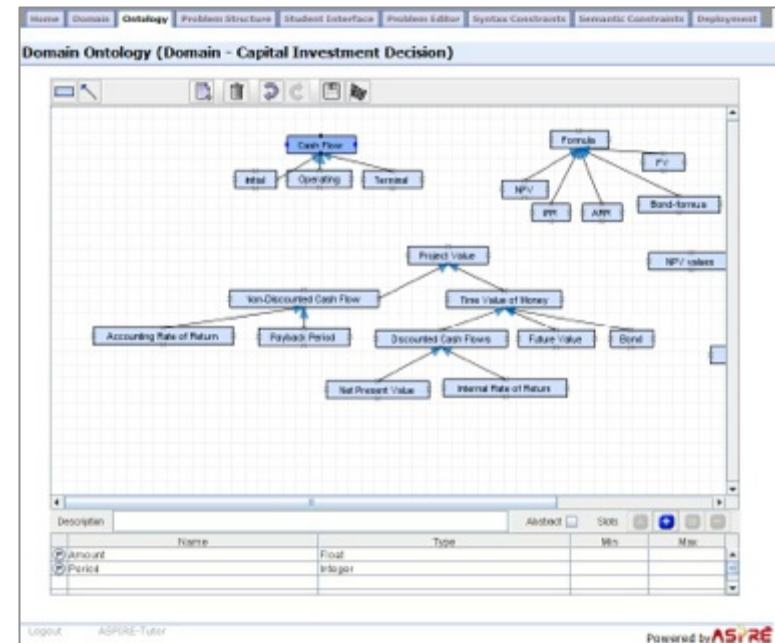


**AutoTutor Script Authoring Tool
(ASAT)**

Related Work

ASPIRE [Mitrovic 2009] is a web-based tool for creating constraint-based tutors:

- Model problems & solutions
- Design student interface
- Authoring-server
- Deployment-server



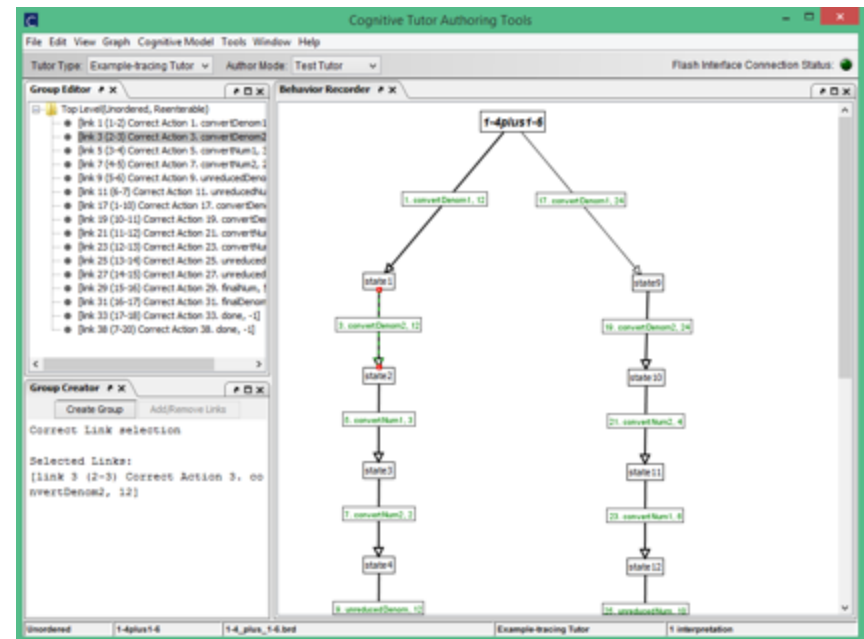
ASPIRE

Related Work



CTAT [Alevan 2009] facilitates the development of cognitive tutors:

- Example-tracing tutors
- “Mass Production” to speed up content creation
- Used by non-programmers



**Cognitive Tutor Authoring Tools
(CTAT)**

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LEONARDO CyberPad Tablet Deployment



LEONARDO CyberPad Laptop Deployment



LEONARDO CyberPad



iPad 6:07 PM 100%

Welcome	What do you think the word energy means?	
Introduction	The word energy means the ability to do work make things move or happen it comes in different forms such as hest light motion chemical and electrical	
Write what you know		Finished
A Flashlight	What can energy be used for?	
Flashlight Parts	Energy can be used for tv phones computuers and tabalats phone wires the building that runs off of	
Circuits		Finished
Vocabulary	Where does energy come from?	
Safety Alert	Energy comes from a d-cell souces	
Focus Question		Finished
Make a Prediction		
Virtual Lab		
Return to Focus Question		
Vocabulary Review		
Review Questions		
Thanks!		

Agenda Investigations

Think back to your experiences and give me more information in your scientific explanation.

A 3D rendered cartoon character of a scientist, colored green, wearing a white lab coat and brown-rimmed glasses. The character is standing on a blue grid floor. A yellow speech bubble with a black silhouette of a head and sound waves is positioned above the character's head, containing the text 'Think back to your experiences and give me more information in your scientific explanation.' The speech bubble has a tail pointing towards the character.

LEONARDO CyberPad


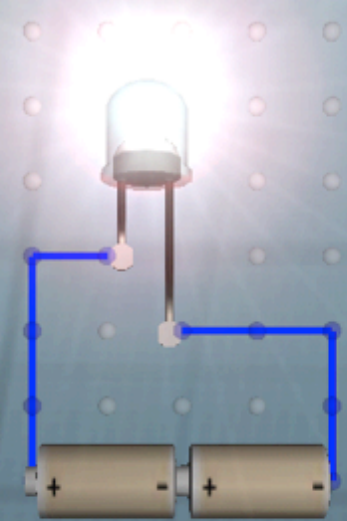
iPad 12:19 PM 95%

Welcome
Introduction
Vocabulary
Safety Alert
Focus Question
Make a Prediction
Virtual Lab
Test Prediction 1
Test Prediction 2
Test Prediction 3
Test Prediction 4
Test Prediction 5
Test Prediction 6
Return to Predictions
Return to Focus Question
Vocabulary Review
Review Questions

Record your observation: did the light bulb light?

Agenda Investigations

I'm holding an image of the first circuit you made a prediction for. Make a circuit that represents the pattern on the card and record whether it lights or not.



Tool: Wire Clear All Finish

LEONARDO CyberPad

iPad 12:29 PM 96%

Introduction What do you notice about the particles inside the straw, the magnet, and the paperclip? (Which particles are similar, which are different?)

Focus Question

Investigation 1 Finished

Science Fact 1 Clear All

Science Fact 2

Investigation 2

Science Fact 3

Science Fact 4

The Magnifier Tool

Zoom In!

Instructions

Try it

Return to Focus Question

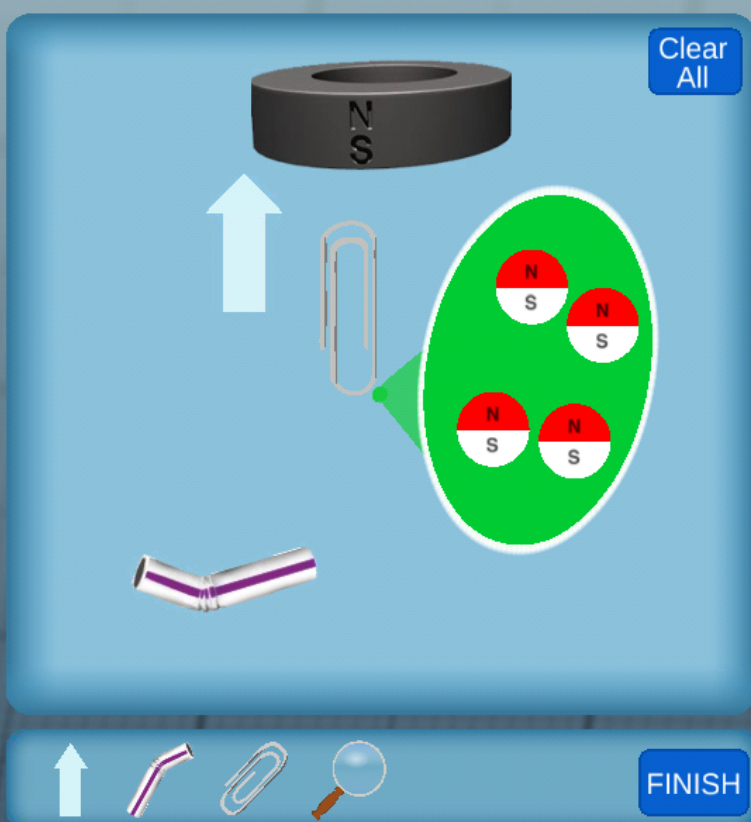
What I learned today

Review

Thanks!

Agenda Investigations

Drag the Magnifier onto the straw, paperclip and magnet. What do you see? Use your observations to answer the questions at the top of the page.



The simulation interface features a central workspace with a blue background. At the top, a black cylindrical magnet is labeled with 'N' and 'S'. Below it, a silver paperclip is shown. To the right, a green oval magnifier tool displays four particles, each with a red 'N' and a white 'S' pole. At the bottom, a purple and white straw is shown. A light blue arrow points upwards from the straw towards the magnet. A 'Clear All' button is located in the top right of the workspace. A scientist character with glasses and a white lab coat stands on the right side, with a speech bubble containing instructions. A 'FINISH' button is at the bottom right of the interface. A bottom toolbar contains icons for an upward arrow, the straw, the paperclip, and the magnifier.

LEONARDO Multi-State Deployment



- States: 8
- Classrooms: 38
- Students: 912

LEONARDO Curricular Content



- Initial curricular content:
 - Energy & Circuits
 - Magnetism
- Based on Full Option Science System (FOSS)
- Includes physical and virtual experiments



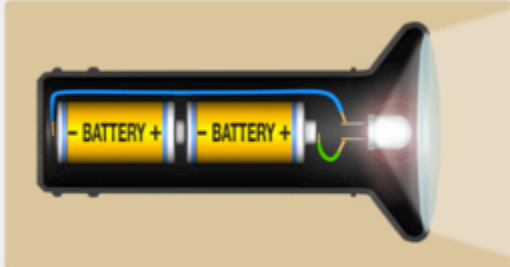
Pages
Reader
CyberPad Save Sign out

< Investigations

Pages

- Welcome
- Introduction
 - Write what you know
 - A Flashlight
 - Flashlight Parts
 - Circuits
- Vocabulary
- Safety Alert
- Focus Question
- Make a Prediction
 - Science Fact
 - Make Predictions
 - Explanation
- Virtual Lab
 - Test Prediction 1
 - Test Prediction 2
 - Test Prediction 3

For a flashlight to work, it needs to have two things. It needs to have batteries and a light bulb. They each have their jobs to do. Which one of them provides energy to run the flashlight, and which one changes the energy into light?



This is a static text entry. Replace this text with your own text.

A changes energy into light.

Replace this text with instructions for an essay question.

Common

CreatedDate	11/14/13 9:27:04 PM -05:00
Id	806878a8-6531-fb60-5ed0-bc6eb1
LastModifiedBy	rob
ModifiedDate	11/14/13 9:27:04 PM -05:00
Name	New MultipleChoice
Revision	7
Tags	

Input Entry

EnableFinishedBy

ReadOnly

Layout

Margin 0.0.0.0

Multiple Choice Entry

Choices Total: 3

QuestionText A <select/> provides the energy

User Data

InternalDataKey	MultipleChoiceEntry-677d
UserDataKey	Provides Energy

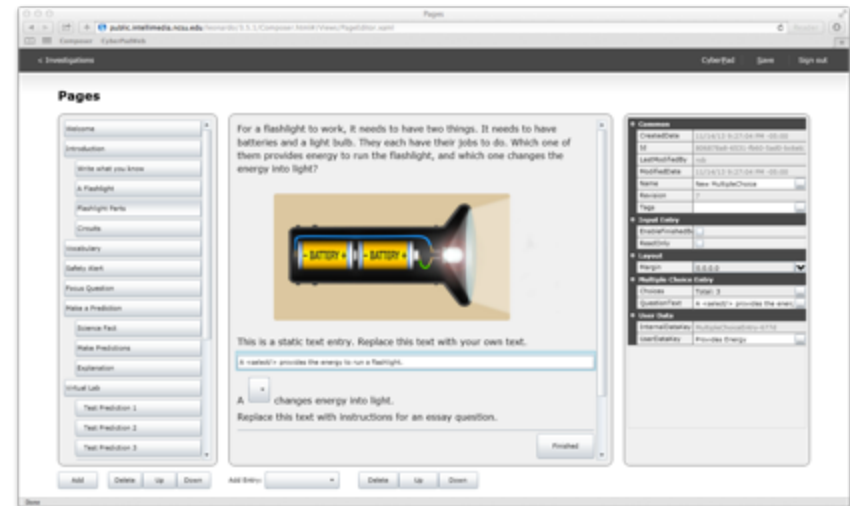
Add Entry:

LEONARDO Composer



Authors use Composer to create:

- Curricular content
- Agent dialogue
- Agent behavior



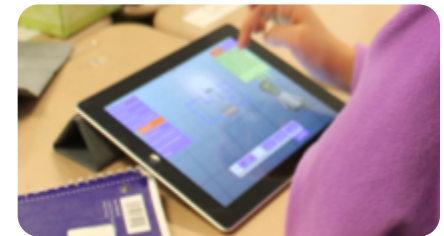
Prior to Composer

Original authoring workflow:

- Word used to author curriculum and agent dialogue
- Doc copied into XML
- XML embedded in the iPad app
- Agent behavior authored in code by software engineers



<XML />



Prior to Composer



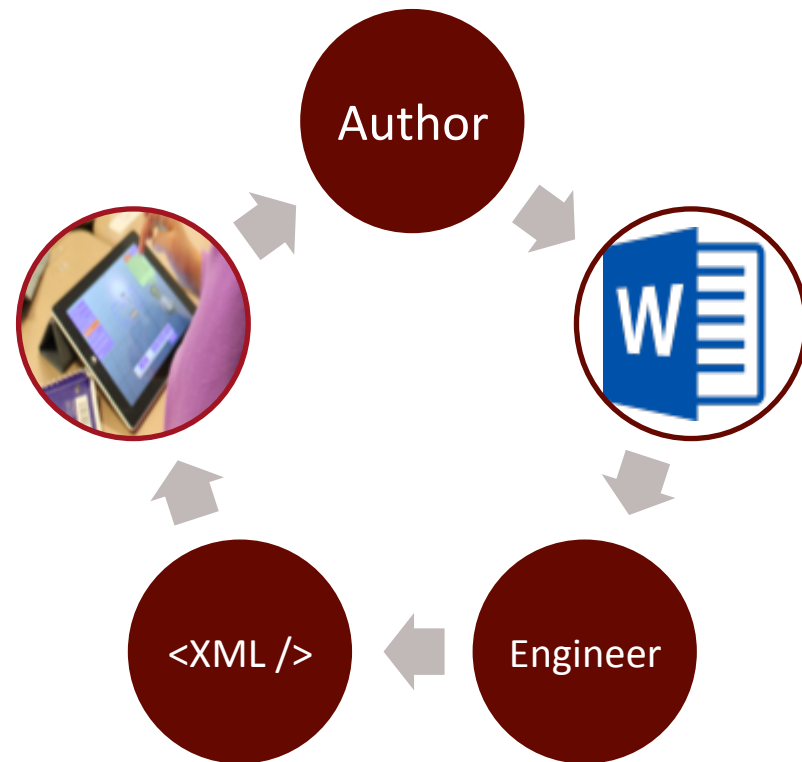
The following people were made sad by the original authoring workflow:

- John Bedward, *STEM Education*
- Courtney Behrle, *STEM Education*
- Michael Carter, *English*
- Kirby Culbertson, *Art and Design*
- Samuel Leeman-Munk, *Computer Science*
- Bradford Mott, *Computer Science*
- Lindsay Patterson, *STEM Education*
- Marc Russo, *Art and Design*
- Angela Shelton, *STEM Education*
- Ruth Sirkin, *STEM Education*
- Andy Smith, *Computer Science*
- Robert Taylor, *Computer Science*
- Eric Wiebe, *STEM Education*

Prior to Composer

Drawbacks:

- 15+ minute iteration
- Lack of WYSIWYG
- “Collaboration” by e-mailing Word docs
- Prone to programmer error
- Rules authored in source code



Lesson Learned: Create an Authoring Tool



- Identify authors:
 - STEM experts
 - K-12 teachers (future)
- Identify familiar tools
- Design workflow based on familiar UIs & features
- Iteratively develop Composer based on author feedback



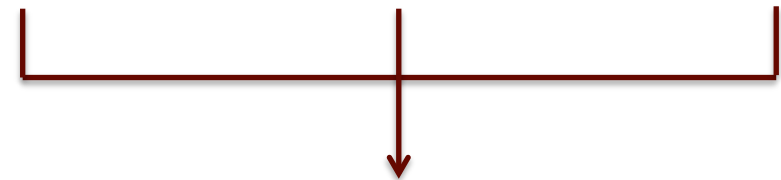
Edmodo



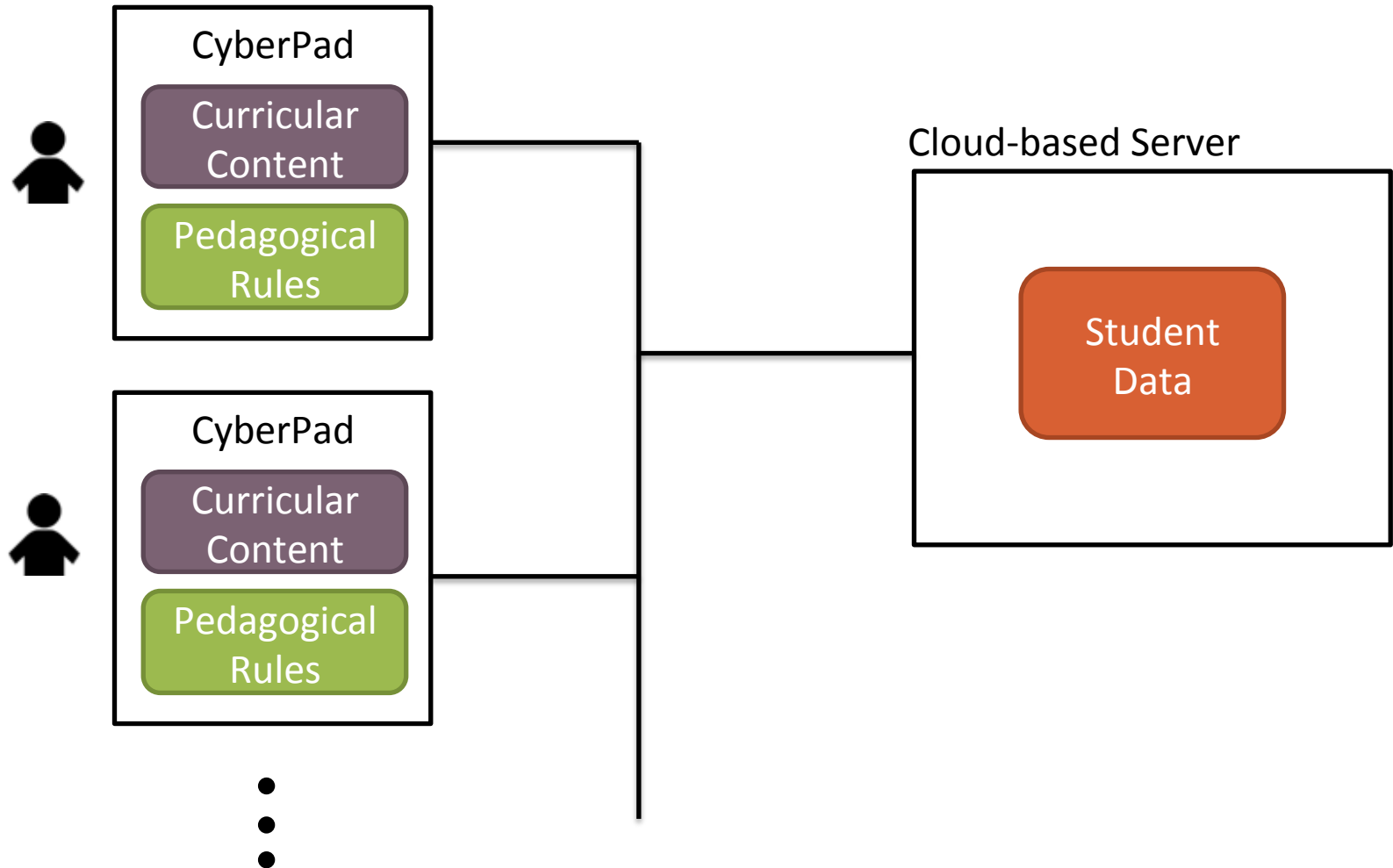
Google Docs



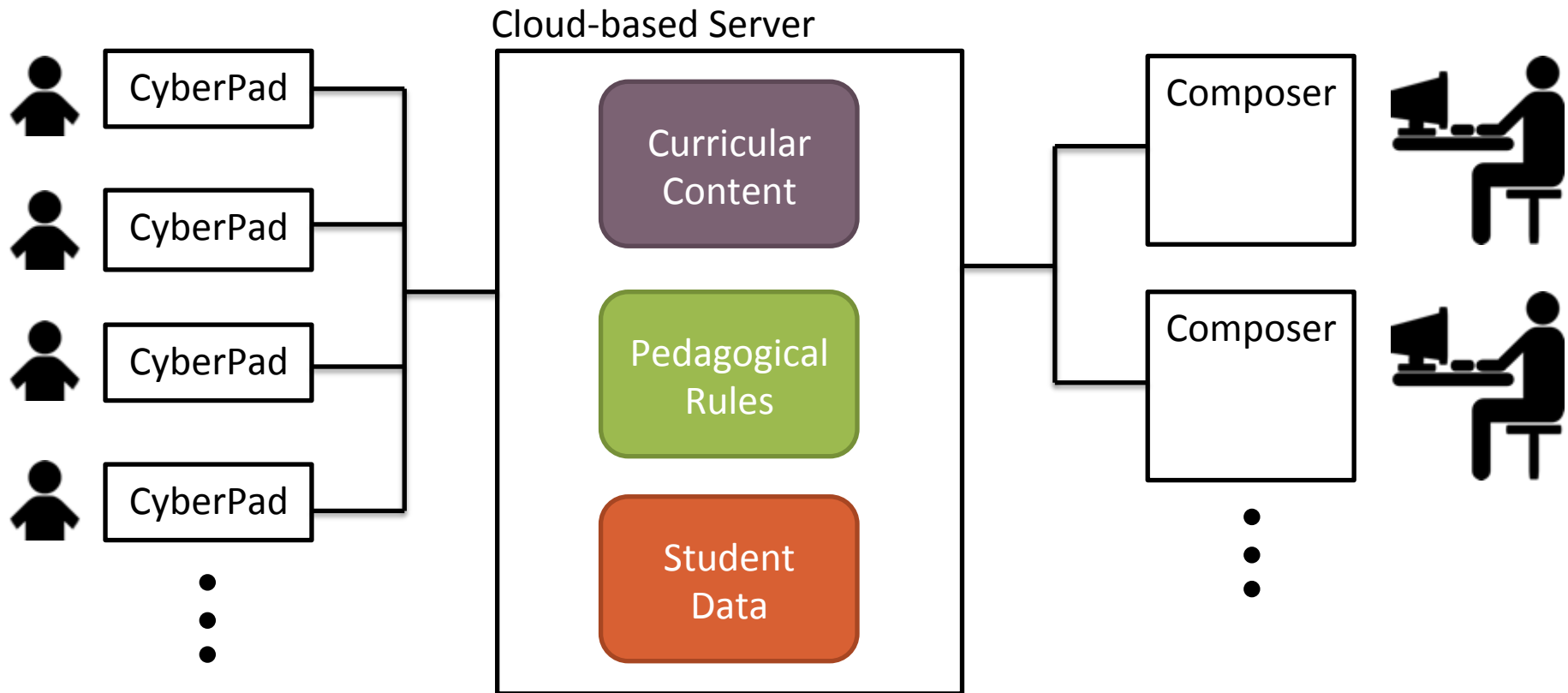
PowerPoint



LEONARDO Architecture Prior to Composer

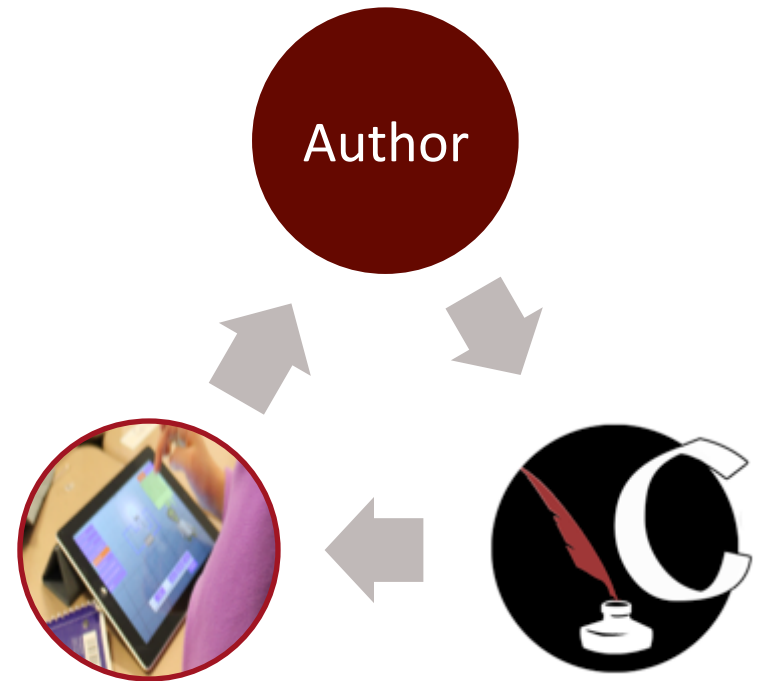


LEONARDO Architecture with Composer



Composer Features

- Simplified workflow
- Familiar UI
- Rapid iteration
- Curricular content stored in cloud
- Web-based authoring tool



Outline

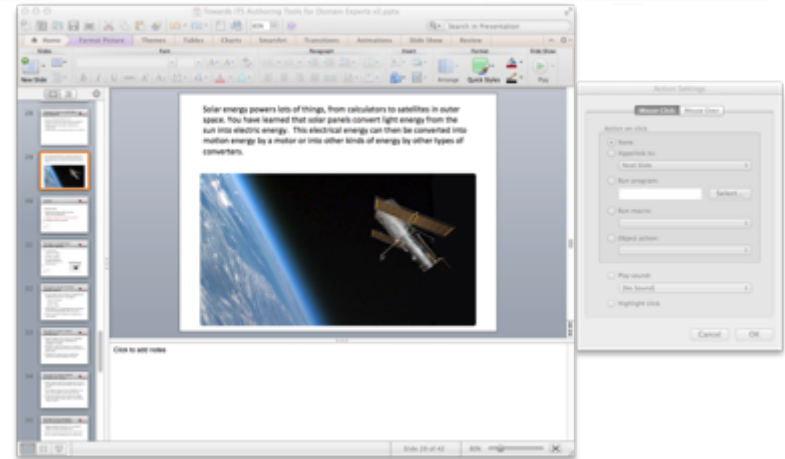


- Related Work
- Case Study: Authoring the LEONARDO Digital Science Notebook
- **Design Principles for ITS Authoring Tools**
- Conclusion and Future Work

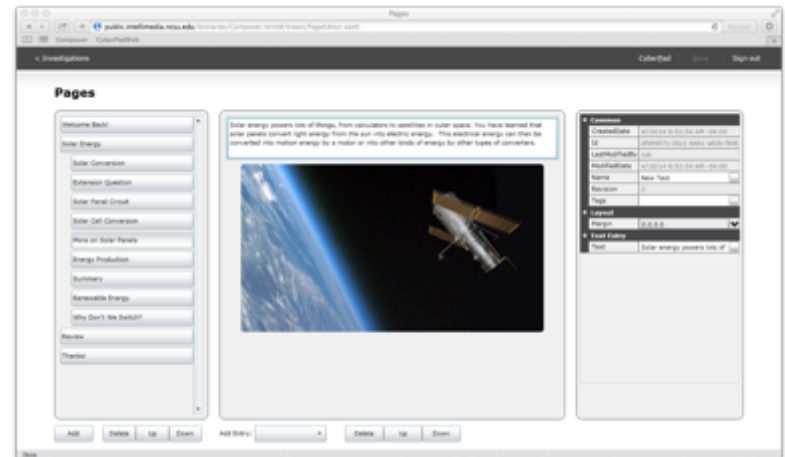
Principle 1: Familiar User Interface Paradigm



- UI is the most important feature
- Familiar to author
- Leverage decades of usability and efficiency improvements



PowerPoint



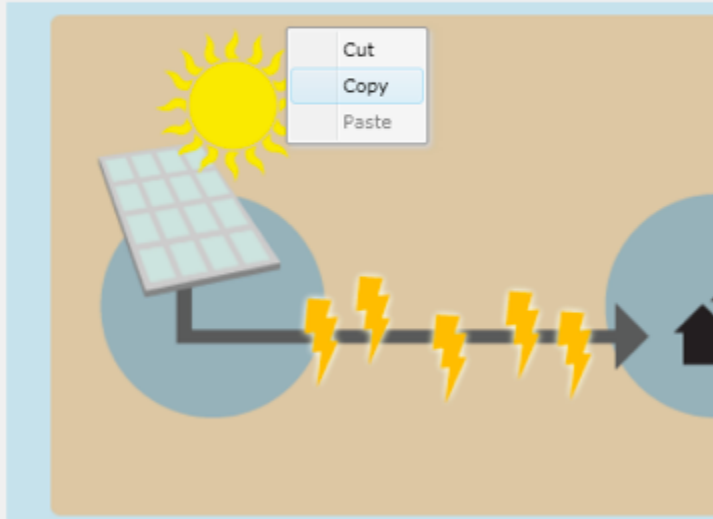
Composer

Principle 2: Standard Editing Features

- Relied upon by authors
 - Copy, Cut, and Paste
 - Undo and Redo
 - Revision Tracking
- Can profoundly affect curricular content storage
- Should not be left as a feature to be added at the end of project

How much energy can solar cells produce?

Large solar panels can produce enough energy to supply a house or even a factory. When hundreds of solar panels are put together, they can supply enough electricity for a whole town.

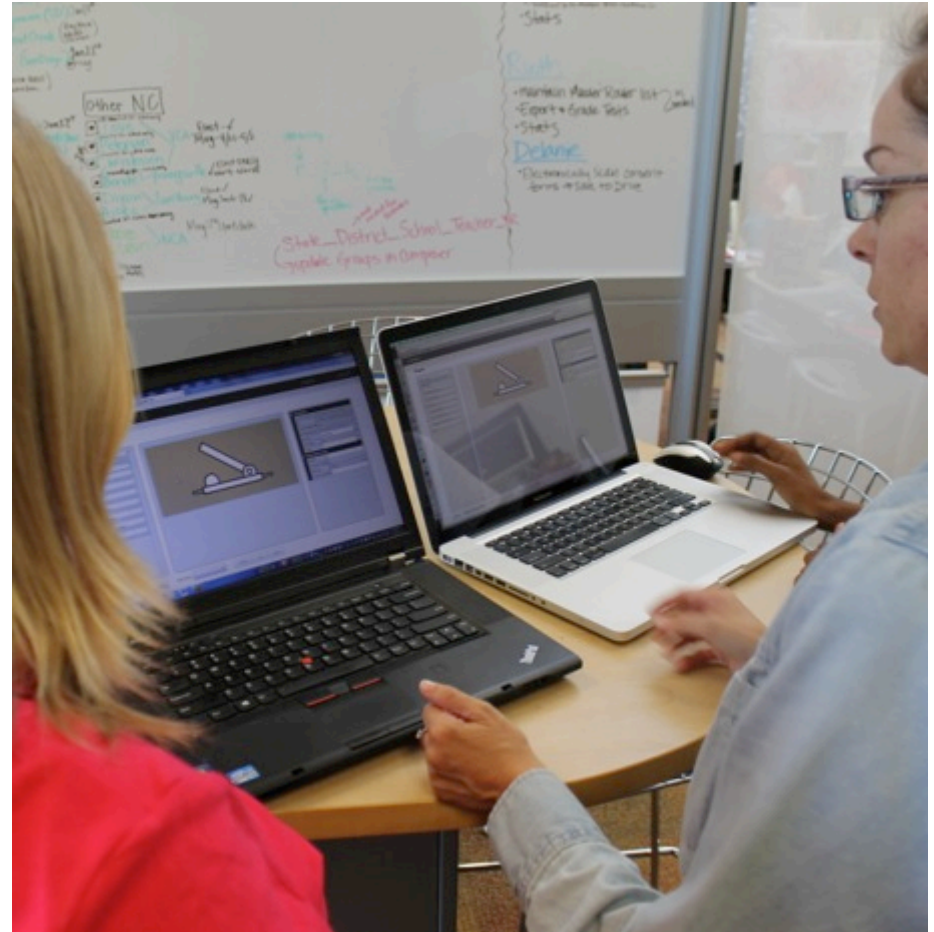


The diagram illustrates the process of solar energy production. On the left, a yellow sun is positioned above a solar panel. A black line representing an electrical wire connects the solar panel to a house on the right. Along this wire, several yellow lightning bolts are shown, symbolizing the flow of electricity. A context menu is overlaid on the diagram, containing three options: 'Cut', 'Copy', and 'Paste', with 'Copy' highlighted in blue.

Principle 3: Author Collaboration

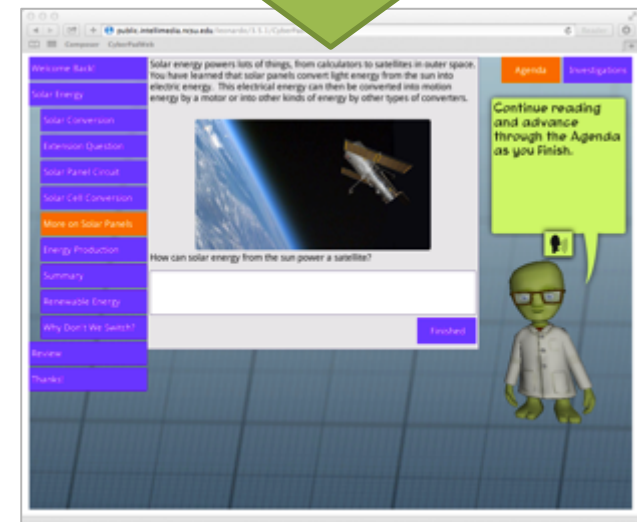
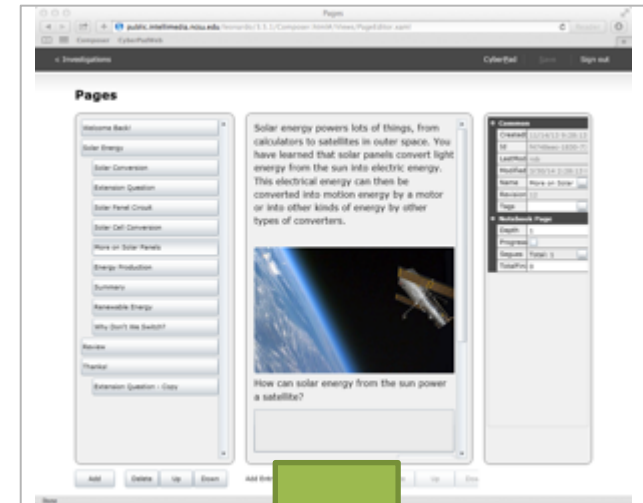


- Multiple author collaboration
- Facilitates communities of authors
- Increase both quality and quantity of content



Principle 4: Rapid Iteration

- WYSIWYG or live connection to the ITS
- Changes can be quickly seen in the context of the ITS
- Test ITS behavior while editing rules



Principle 5: Accommodate Novice and Expert Authors



- UI tailored to novice and expert users
- Wizard interfaces for novice users
- Advanced authoring UI for expert users

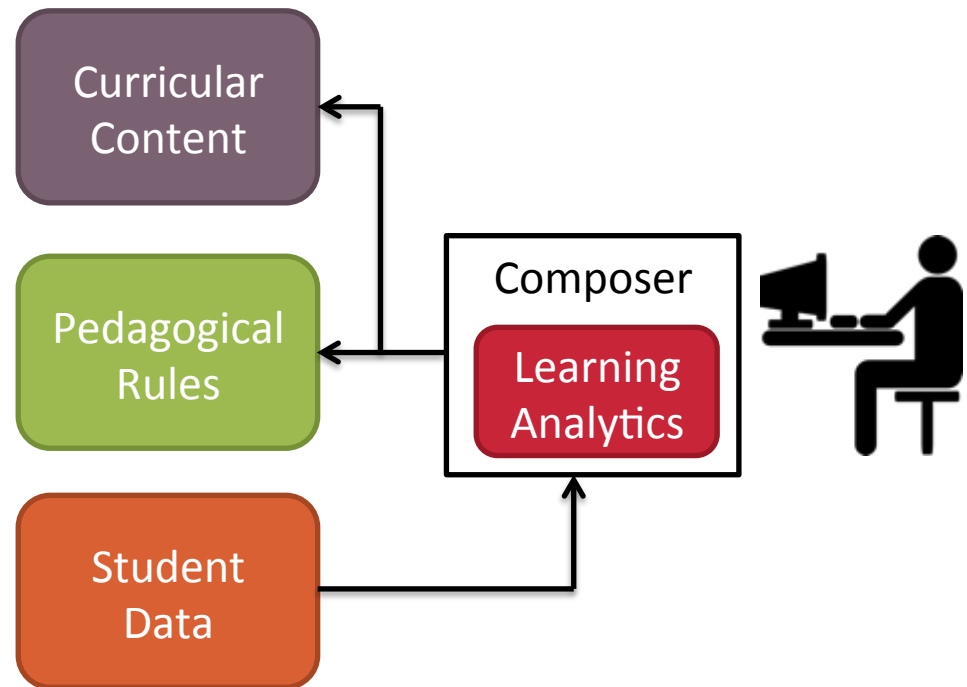
The screenshot displays two sections of a properties panel. The top section is for an **EssayRule** and the bottom section is for a **Dialog**.

Properties:	
EssayRule	
Condition	DoesNotIncludeAnyOfTheseWords
ConditionParameter	convert electricity
DialogMoves	Total: 0

Properties:	
Dialog	
DialogMoveType	Hint
Level	2
PadMate Action	
Gesture	Thinking
Image	
Repeatable	<input checked="" type="checkbox"/>
Verbal	A solar panel converts energy.

Principle 6: Automation

- Some tasks too labor intensive
- Provide automation for repetitive tasks
- Learning analytics to highlight curricular “hot spots”



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Conclusion



- Widespread deployment of ITSs depends on efficient transfer of domain knowledge
- Authoring tool design can leverage decades of software UI and workflow evolution
- Authoring tools hold great promise to facilitate rapid creation of ITSs

Future Work



- Apply learning analytics to identify parts of the curriculum that need additional scaffolding
- Introduce intelligent user interface to facilitate accelerated development of content by novice authors
- Investigate the effects of these capabilities on author efficiency and curricular content quality

Acknowledgements



Collaborators

- John Bedward, *STEM Education*
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- Michael Carter, *English*
- Kirby Culbertson, *Art and Design*
- Christopher Mitchell, *Computer Science*
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- Eric Wiebe, *STEM Education*

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Contact

rgtaylor@ncsu.edu

