Learning Innovation Summit 2018
Effective Digital Learning Innovation in the Sciences

BROUGHT TO YOU BY

[Logos of NASA, SMART SPARROW, ASU Arizona State University, ACTNEXT, inspark, Infiniscope]
HERA

ACTNext & Smart Sparrow jumping in!
Collaborative effort

ACTNext team
Meirav Arieli-Attali
Sue Ward
Jay Thomas

Sponsor: Alina von Davier

SmartSparrow team
Jaime LeQuin
Ali Siddiqui
Ben Barefield

Sponsor: Amanda Newlin
Meet HERA!

An Adaptive
  • Holistic
  • Educational
  • Resources and
  • Assessment System
for Science

--Research-based prototype
--Bridging assessment & learning
--Started piloting in May, 18
--Adaptive scaffolding
--Adaptive algorithm
--Basis for automatic Item generation
System Characteristics

- **Student-controlled navigation**
  - Student takes ownership of their learning / self-regulated learning → motivation

- **Interactivity**
  - Feedback and responsiveness according to student actions

- **Transparency**
  - Scores on progress and on “holes” in knowledge provided

- **Gamification**
  - Elements from games incorporated (i.e., badges, dynamic dashboards)

- **Adaptivity**
  - Scaffolds and hints within a task/item
  - Item-by-item or unit-by-unit adaptivity / suggestions for planned practice

- **Automatic Content Generation**
  - Item models
Linking Assessment and Learning

• **Learning → Assessment**
  - Incorporate assessments/quizzes within a learning system

• **Assessment → Learning**
  - Accompany assessment results with actionable recommendations for teachers (formative assessment movement)

• **Assessment ←→ Learning**
  - Link between established (valid & reliable assessment) and established learning resources

• **Blended approach**
  - Differ than Intelligent Tutoring System (ITS)
  - Hints vs. Scaffolds

Drawing on our knowledge and expertise in assessment and measurement
Simulation

- Learning by doing
- Introduction to the content – familiarity
- Allow exploration
- Not scored
- Opportunity to “collect data”
Building blocks - Item sets

ACT science test
• Scientific Passage
  • w/tables & graphs
• Assessment items (6-7 questions)

HERA lesson
• Scientific simulation
  • w/table for data collection
• Assessment & learning items (10 questions with help options upon incorrect response)
Learning Scaffolded Item (LSI)

- First attempt – looks like a regular test item
- After incorrect response
  - Rephrase → try again
  - Break it down → try again
  - Teach me → try again
  - Skip
Here are the results of the drop test for two different balls: a tennis ball and a baseball.

<table>
<thead>
<tr>
<th>Drop height (m)</th>
<th>Height attained (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tennis Ball</td>
</tr>
<tr>
<td>0.40</td>
<td>0.30</td>
</tr>
<tr>
<td>0.80</td>
<td>0.60</td>
</tr>
<tr>
<td>1.00</td>
<td>0.75</td>
</tr>
<tr>
<td>1.20</td>
<td>0.90</td>
</tr>
<tr>
<td>1.40</td>
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</tr>
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How much total distance did the tennis ball travel from its highest drop height until it bounced to its restitution height?
...after incorrect response

Question 6

Here are the results of the drop test for two different balls: a tennis ball and a baseball.

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The question asks you to locate the highest drop height for the tennis ball in this table, then locate the result of this drop (the height attained for that drop), and add-up these two distances.

1.6 m
...after incorrect response

Question 6

The first step to answer this question is to find the appropriate cells in the table.

Drop Test Results for a Tennis Ball and a Baseball

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How much total distance did the tennis ball travel from its highest drop height until it bounced to its restitution height?

1.6 m

Break it down option
The total distance a ball travels is the sum of the drop height and the height attained. For example, when the tennis ball is dropped from a height of 0.40 m, its height attained is 0.30 m and the total distance is therefore found by $0.40 + 0.30 = 0.70$.

How much total distance did the tennis ball travel from its highest drop height until it bounced to its restitution height?

1.6 m
Demo
**Hints vs Scaffolds**

**Hint**
- suggest or indicate something *indirectly or covertly*
- Connotation: cheating not fair/peaking
- Hint is suggested in the way to the solution
  - Carnegie Learning
    - First hint = redirect “back to question”
    - Second hint = “true hint” (use formula)
    - Third hint = the solution

**Scaffold**
- a temporary structure for support while in need
- Connotation: building scaffolding/bicycle scaffolding (towards independence)
- Scaffolds can be offered while learning (also after giving a response)
  - HERA system
    - First scaffold = rephrase
    - Second hint = break it down
    - Third hint = teach me
Scaffolds before or after?

Scaffold before response

From user experience view

• Why shouldn’t I try these hints before I put effort in answering this question?

→ “hint abuse” /bottom-out hint

From psychometric view

• How do we assess the knowledge, skill and ability after hint was used?

Scaffold after response

From user experience view

• Second chance after incorrect response (given only when needed)

→ invoke wish for learning?

From psychometric view

• We can assess the knowledge, skill and ability based on the item response
The expanded ECD (e-ECD) Framework

**The e-Student model**
- **KSA model**
  - A model for latent knowledge, skills and ability (KSA)

**The e-Evidence model**
- **Knowledge-Evidence model**
  - Links between tasks observables and inference about KSA

**The e-Task model**
- **Task model**
  - Features of tasks that allow collecting observables about KSA

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**Assessment**
- **Change in KSA model**
  - A model for latent learning processes
  - How to move from one state of KSA to a higher KSA (change in KSA)

**Learning**
- **Learning-Evidence model**
  - Link between task observables (and process data) and inference about change in KSA

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**Task-Supports model**
- **Task-Supports model**
  - Features of tasks that
    1. Support and enable learning
    2. Enable collecting observables about change in KSA
Three Related Disciplines

- Learning Theories
- Pedagogical Principles
- Lesson Design

Learning & teaching

Technology

Technological capabilities in
- Presenting information
- Collecting data

Assessment

Test Theory
Validation Principles
Assessment design
A Triple Marriage

Learning Theories
Pedagogical Principles
Lesson Design

Learning & teaching
Educational Technology

Technology

Assessment

Formative Assessment (FA)
Learning & Assessment Systems (LAS)

Test Theory
Validation Principles
Assessment design

Intelligent Tutoring Systems (ITS)

Technology Enhanced Assessment (TEA)
Computer Based Tests (CBT)
Big Data

Technological capabilities in
- Presenting information
- Collecting data
What does this mean for Smart Sparrow?

- This research project guide will guide product development decisions
- Opportunity to dig into continual assessment that is integrated with learning
- Qualitative evaluation of design decisions