



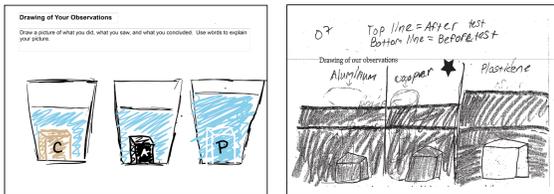
Interactive Ink Inscriptions in K-12

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Introduction

INK-12 is investigating how pen-based interaction and wireless networking can support teaching and learning mathematics and science in upper elementary school.

Pen-based interaction enables creation of inscriptions (e.g. writing, sketches, graphs) which are critical in STEM, where content is expressed using both text and drawings.



Wireless networking enables inscriptions to be communicated among teachers and students, supporting formative assessment and classroom discussions on student work.

Using our **Classroom Learning Partner** (CLP) software, students **create** inscriptions using digital pens, CLP **interprets** the inscriptions, and students and teacher **share** the student work.

Students can create inscriptions by drawing or using representations we call “structured vocabularies,” which have pre-defined meanings. Stamps and tiles are examples.



Research Questions

1. How do inscriptions created using digital pen-based technology differ from those created using pen and paper?
2. How can structured vocabularies enhance students' inscriptions and the ability of the software to interpret student work?
3. What tools can effectively support teachers in selecting student work for classroom discussion?
4. How does the use of technology for submitting and sharing student work change classroom participation structures?

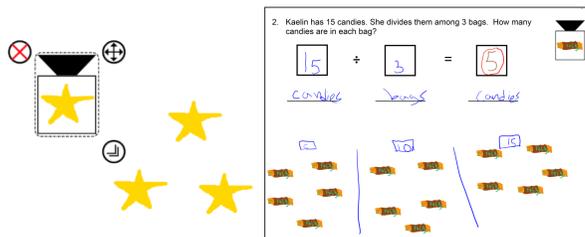
Model of Interaction

Create



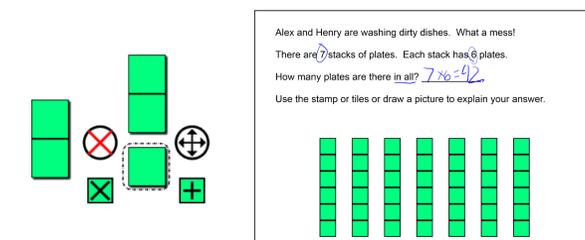
Student-created Stamps

Creating representations with multiple copies of identical groups can support students' understanding of multiplicative relationships. In CLP, students can create their own replicable images by drawing on a blank stamp.



Snappable Tiles and Towers

Students can create towers by joining a set of “snappable” tiles, then treat the towers as objects that they can duplicate or modify.



Audio Explanations

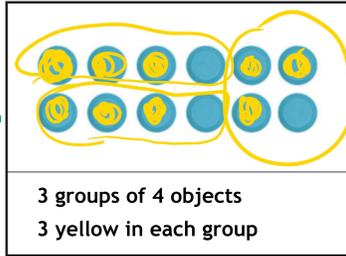
Elaborating on mathematical statements or scientific observations is key to students' developing advanced reasoning skills, but writing can be a barrier. Students can create audio recordings to explain their written work.

7. Number puzzles! For each puzzle, find an answer that matches the clues and record an explanation of how you found it.

- a. This number is a multiple of 5. This number is odd. This number is greater than 50. This number is less than 70.



Interpret



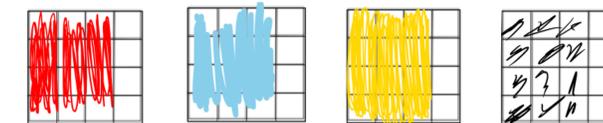
3 groups of 4 objects
 3 yellow in each group

Student Work Interpretation

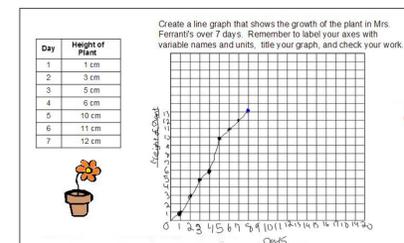
Sorting and choosing student work for class discussion can be overwhelming for teachers. To help with this task, CLP uses artificial intelligence techniques to interpret and group student work. In some cases, handwriting recognizers can interpret student work, though unexpected strokes or messiness can cause problems.



Answers that involve shaded regions can be interpreted and grouped based on percentage and locations of grid cells containing ink strokes. Fraction problems are an example.



Structured vocabularies, such as stamps or tiles, facilitate interpretation, as the computer will “know” what icon a student has used and what it represents. A graph plotted on a grid also has enough structure for the computer to interpret.



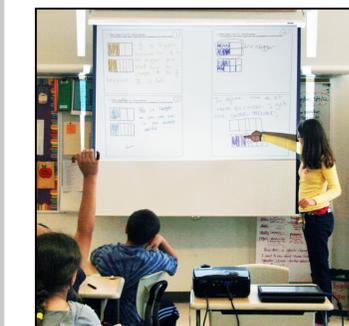
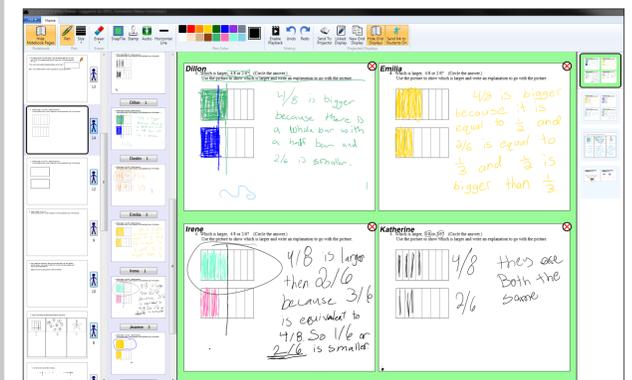
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Share



Class Discussion

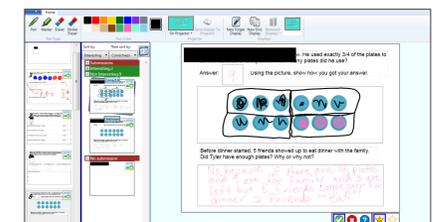
Teachers can display and annotate examples of student work as a basis for class discussion.



Student work is identified by name on the teacher's machine, but projected anonymously.

Smart Sorting

Based on computer interpretation or teacher-assigned tags, CLP can sort student work according to correctness or “interestingness.”



Find us online: <http://ink-12.terc.edu/>