INK-12:
Interactive Ink Inscriptions in K-12

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This project explores the use of a wirelessly connected set of tablet computers in elementary and middle school math and science classrooms. In particular, the project focuses on the use of this technology to support the ***creation*** and ***communication*** of inscriptions—handwritten sketches, graphs, maps, notes, etc. Our study investigates inscriptions created using "digital ink" available via a tablet computer's ***pen-based interface*** and shared between teacher and students via the computer's ***wireless communication***. We believe that numerous aspects of the tablet computers have the potential to improve student learning: Students can create, duplicate, and alter mathematical and scientific inscriptions to share, possibly anonymously, with the teacher and other students. Teachers can choose several of these inscriptions to publicly display and discuss with the class. (In the photograph at right, the teacher has chosen one of the students' submissions to share with the class.) This technology may have the potential to particularly benefit lower-performing students, as teachers can provide appropriate resources for students wirelessly "just in time" as they circulate among the students. This project seeks to identify advantages and disadvantages of a network of tablet computers, to understand what challenges and benefits such technology offers to teachers, and to provide recommendations for future hardware, software, and curriculum development.

Creation: Pen-Based

Scholars who analyze the nature of scientists' work have cited the "development of representations that render phenomena accessible, visualizable, and transportable" as a critical part of becoming a mathematician or scientist [1, 2]. Recent research on students' use of inscriptions in science uses this insight as a starting point for examining classroom practice [3]. Most of the research about inscriptions, however, has looked at those created "by hand," with pen and paper, or those created by students' mouse and keyboard interaction with computer tools. While computer-based sketches, informal graphs, or hand-drawn data tables could have enhanced the educational impact of inscribing, there has been no easy way to introduce such technology and assess its potential role. This study will investigate now-available technology and its use in K-8 science.

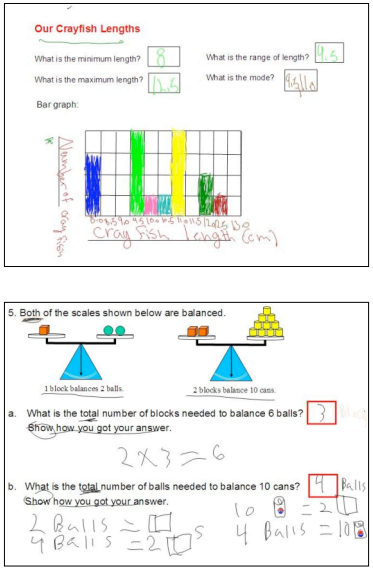

Figure 1. 4th grade student "digital ink" inscriptions

[1] National Research Council (2007). *Taking Science To School: Learning and Teaching Science in Grades K -8.* Washington, DC: National Academy Press.
[2] Lemke, J. (1998). "Multiplying Meaning: Visual and Verbal Semiotics in Scientific Text." In J. R. Martin & R. Vell (Eds.), *Reading Science: Critical and Functional Perspectives on Discourses of Science* (87-113). New York: Routledge.
[3] Kozma, R. B., et. al. (2000). "The Roles of Representations and Tools in the Chemistry Laboratory and their Implications for Chemistry Instruction." *Journal of the Learning Sciences*. 9 (2), 105-143.

Communication: Wireless

Part of the value of inscriptions lies in the conversations and communication around them. As understanding of the critical nature of this communication has grown, a variety of classroom practices has evolved to support conversations among students and teachers. Recent technological innovations have promoted whole-class interaction by introducing a central shared display and by taking advantage of wireless interaction (e.g., [4]). The technology we are using employs both of these techniques for the wireless submission and display of students' "digital ink" inscriptions [5, 6]. The anonymity afforded by the technology provides students, particularly those who might not otherwise participate, with a means of contributing without fear of embarrassment.

[4] Roschelle, J., Pea, R. (2002) "A Walk on the Wild Side: How Wireless Handhelds May Change CSCL." In *Proceedings of CSCL 2002*, Lawrence Erlbaum, Hillsdale NJ, 51-60.
[5] Anderson, R., et. al. (2004) "Experiences with a Tablet-PC-based Lecture Presentation System in Computer Science Courses." *Proceedings of SIGCSE '04.*
[6] Koile, K., et. al. (2007). "Supporting Pen-Based Classroom Interaction: New Findings and Functionality for Classroom Learning Partner." *Proceedings of the First International Workshop on Pen-Based Learning Technologies 2007.*

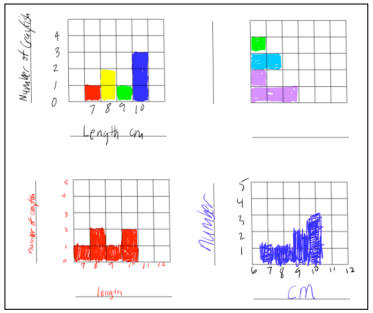

Figure 2. Student inscriptions to be viewed publicly

I could review students' work and select samples to display on the [public] screen. It was a wonderful opportunity for the children to see a variety of ways to solve the same problem.

4th grade teacher

You don't have to be embarresed [sic] about your work. Also, it gets kids eager to do math and makes math more fun.

4th grade student

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