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A Smart Classroom Technology Framework: Supporting Collaborative Visualizations

How can we deliver on the promise of technologies for education and help learning become more social and engaging for students? The Internet and other technologies have transformed nearly every aspect of our society, particularly in the scientific and commercial sectors, yet classrooms of today appear largely as they did more than 50 years ago (Tyack and Cuban, 1999; DiSessa, 2000). This contrasts with students' experience outside of the classroom, as evidenced by the explosion of the social web (Web 2.0), where interactions and learning have increasingly become collective products rather than individual efforts.

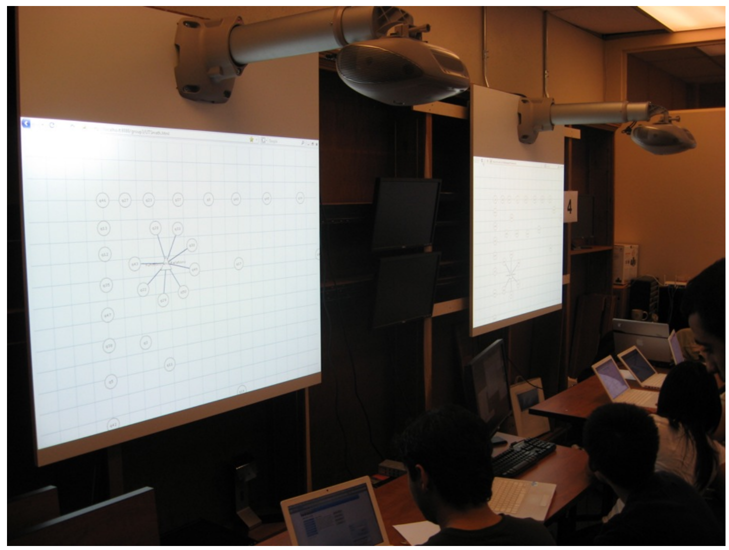
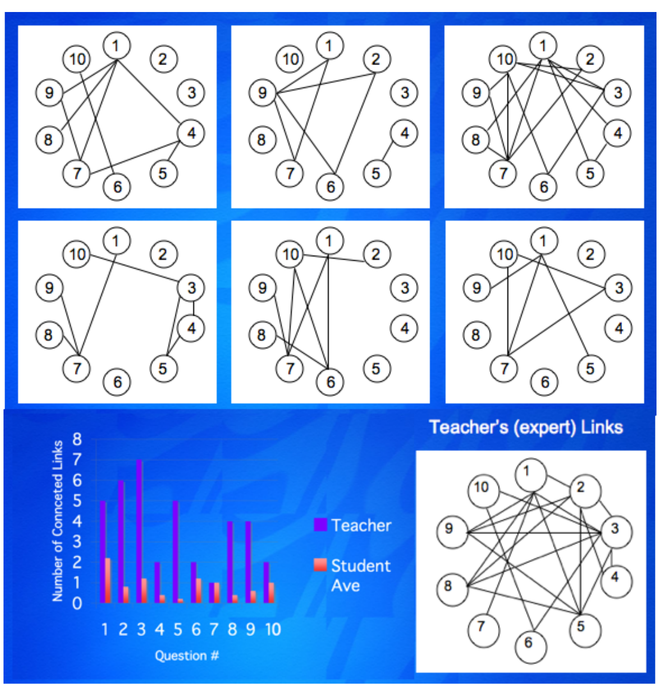


Figure A: Smart classroom setup integrating large projection screens, laptops, and touch wall

In response to these challenges, we are developing a "smart classroom" infrastructure (see Figure A) to facilitate cooperative learning that leverages physical and semantic spaces to achieve innovative pedagogical formats. Our framework supports: aggregating, filtering and representing information on various devices and displays; locational dependencies (i.e. different things happen depending on students' location within the room); interactive learning objects, and an intelligent agent framework. This powerful, customizable learning environment supports the coordination of people, activities and materials with real-time sensitivity to inputs from students, servers, and researchers.



Our first project was developed in conjunction with a local high school math teacher, we co-designed a curriculum project for the smart classroom to help respond to the teacher's concern that students did not grasp the interconnections between branches of mathematics, instead perceiving math as consisting of discrete elements as represented in textbook chapters. Students individually logged into laptops, were automatically grouped and placed at one of the room's visualization displays, and asked to "tag" (label) a total of 30 questions. Each group's display showed a graphical visualization of their responses. Students were then asked to collaboratively solve their tagged questions and vote and comment on the validity of other groups' tags. A central display showed a larger real-time aggregate of the all groups' tags as a collective association of links. As students voted on these tags, positive votes resulted in thicker link lines than those that fostered disagreement.

Our current phase of the project has moved to Physics curriculum development in two schools – the same high school as in the Math run, and a large CEGEP college in Quebec. These projects are designed to further extended the ideas of collaborative aggregation and knowledge development across an entire semester, allowing students to more fully engage with and develop the content within the system. In conjunction with the curriculum development several new interactive technologies are being developed to help foster student interactions both with the content and their fellow students. Of primary note among these developments is the building of a DSI (Diffused Surface Illumination) multi-touch surface table and the integration of Android based smartphones.

The goal of the technology infrastructure under development is to allow information to flexibly move across platforms, devices and users. For example - students can create, annotate, and discuss content on their laptops; the content can be broadcast in real-time onto the multiple displays around the room; the content can then be "collected" on the smartphones and tied to individual students' profiles; the smartphones can be placed on the multi-touch surface and connected directly with it, allowing students to display, manipulate, organize, and share their collected content. A main component of this matrix of technology and information exchange is the development of a robust and semiotically natural user interface. Students will be able to tap at an object to get more information, take a picture of it to store it in their "album", slide or fling the object from their phone to the table, or from the table back onto a screen – the idea is not to reinvent how students manipulate objects but integrate already learned methods of interaction into a technology mediated information space.

;ure B: High variability of six students' ɛ-test responses, and low correlation with ɛcher.

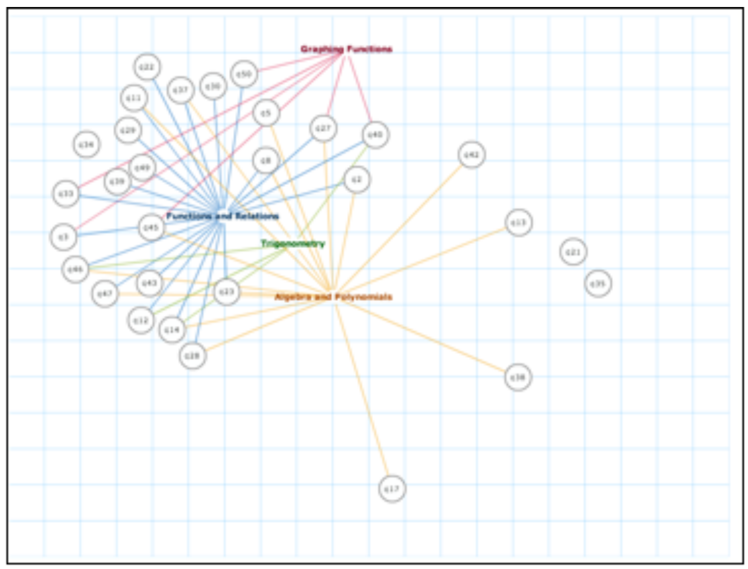


Figure C: Sample of aggregated display of labels resulting from multiple student groups' tags

Tyack, D., & Cuban, L. (1995). Tinkering toward utopia. Cambridge, MA: Harvard University Press diSessa, A. A. (2000). Changing minds: Computers, learning, and literacy. Cambridge, MA: MIT Press.