Knowledge Community and Inquiry about Big Data among High School Students with Interactive Orchestrated Learning Space

Einat Gil, The Fields Institute for Research in Mathematical Sciences, egil767@gmail.com
James D. Slotta, University of Toronto, jslotta@oise.utoronto.ca

Abstract: In this study students engage in learning about Big Data in a Knowledge Community and Inquiry curriculum. Using a design based approach, a three week statistics unit was developed to allow students in a 12th grade mathematics course to explore advanced concepts in Big Data, using interdisciplinary themes. Learning trajectories were guided by an Interactive Orchestrated Learning Space (IOLS), inspired by recent smart classroom and knowledge community approaches (Slotta, 2010; Slotta, Tissenbaum & Lui, 2013).

Introduction

Current developments in data science offer new opportunities for Mathematics, Science and Social Sciences – disciplines that commonly use statistics to analyse data and interpret experimental results. For example, tools for global watch and collection of data through social networks illustrate the growth of data-driven decision-making and the increased awareness for ideas about big data (Agrawal et al., 2012). Yet any applications of big data in statistics education are still in their early stages, typically occur in tertiary education, and almost never at the high school level. Nonetheless, there is growing awareness of the need for students' basic literacy with such data, and the corresponding need to develop frameworks to guide their learning (Philip, Schuler-Brown & Way, 2013). This paper presents our efforts to further the discussion about the role of big data in 21st century learning applications. While it is an evolving area, Beyer & Laney (2012) characterize "big data" according to the four V's: Volume, Velocity, Variety and Veracity (i.e., level of uncertainty of data). Our study incorporates those aspects of big data, adding a perspective of application or usage, to reveal the incredible potential to advance human knowledge while also raising some moral considerations. As high school students could find the analysis of "real" big data to be challenging, we provided various technological scaffolds that served to represent data through visualizations and analytic tools, focusing on the use of mid-size data and illustrative movies.

Our curriculum emphasized knowledge building and design, using a theoretical framework of Knowledge Community and Inquiry (KCI – see Slotta & Najafi, 2013), with three interrelated phases: (1) establishing a community identity; (2) developing shared knowledge through collaborative inquiry; and (3) advancing and interconnecting shared knowledge through further inquiry. Students' inquiry products must also allow for assessment of learning in the targeted domain. We employed a technology-enhanced learning environment to orchestrate students' collaborative and collective activities in the physical classroom space (Slotta, 2010; Slotta, Tissenbaum & Lui, 2013). Following Stahl's insight that CSCL designs should support group meaning making through activities that cross social planes (Stahl, Koschmann & Suthers, 2006), we designed an interactional space to support small group and whole class knowledge building where students can observe one others' reasoning (Coopey, Danahy & Schneider, 2013).

Methods

Our study addresses the topic of how high school students reason about big data concepts and the role played by Interactive Orchestrated Learning Space (IOLS). The research employs a design-based methodology (Brown, 1992), aiming both to develop theoretical aspects of learning about big data and design principles for of learning environments (Design-Based Research Collective, 2003). We ask what types of activities and forms of collaborative knowledge construction are suitable to support KCI curriculum in topics of big data for high school students, and how to support teachers in an orchestrated interactive learning environment, using generic technological platforms. The IOLS approach strives to take into account the classroom as a physical space (Slotta, 2010) as well as a learning community by Community of Learners (Brown & Campione, 1994). We developed a technology infrastructure aimed to tap into the connectivity of the internet and big data resources, using generic collaborative platforms (e.g., Google Docs) for communication and knowledge building that capitalize on the use of intelligent agents, with limited applications of data mining and learning analytics.

Our curriculum focused on reasoning about big data and covariation, consisting of five activities over three weeks, moving between students' *investigations of* mid-size data of a global scale (e.g. Gapminder) to *learning about* big data. Here, we focus on the second activity, which spanned four disciplinary contexts, blending the spatial and interactive aspects of a large classroom space to promote collaboration. The IOLS

(Figure 1) included one Smart board 14 student laptops and eight large (i.e., projected) displays where small groups were orchestrated through a visible 'shared construction of meaning' (Stahl et al. 2006). Students progressed through four distinct interdisciplinary stations: Health, Social networks, Ecology and Surveillance & privacy, interacting with the content using laptops, discussing and taking notes in Google forms, embedded in the unit website.

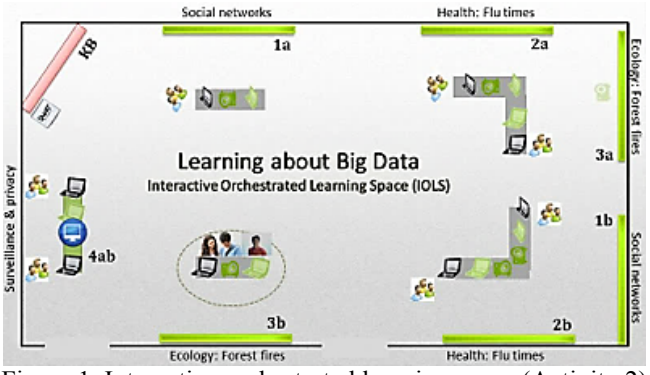

Figure 1. Interactive orchestrated learning space (Activity 2)

Results

This paper reports our approach to introducing big data concepts to high school students, within an Interactive Orchestrated learning Space (IOLS), as guided by the KCI model. The IOLS scaffolded students to add knowledge and engage in media-enhanced activities that crossed digital, physical and social planes, revealing social and ecological applications and ethical considerations. The Smart board showed the accumulating knowledge base from all stations, allowing students to rely on peers' contributions, according to KCI. Our poster will present students' pre-post gains in understanding, as well as the curriculum itself. .

References

Agrawal, D., Bernstein, P., Bertino, E., Davidson, S., Dayal, U., Franklin, M., & Widom, J. (2012). Challenges and opportunities with big data. *A community white paper*.

Beyer, M. A. & Laney, D. (2012). *The importance of big data: A definition*. Stamford, CT: Gartner.

Brown, A. L. (1992). Design experiments: Theoretical and methodological challenges in creating complex Interventions in classroom settings. *Journal of the Learning Science, 2*, 141-178.

Brown, A. L., & Campione, J. C. (1994). Guided discovery in a community of learners. In K. McGilly (Ed.), *Classroom lessons: Integrating cognitive theory and classroom practice* (229-270). Cambridge: MIT.

Coopey, E., Danahy, E., & Schneider, L. (2013, February). InterLACE: interactive learning and collaboration environment. In *Proceedings of the 2013 conference on CSCW* (pp. 11-14). ACM.

The Design-Based Research Collective. (2003). Design-based research: An emerging paradigm for educational inquiry. *Educational Researcher*, 5-8.

Philip, T. M., Schuler-Brown, S., & Way, W. (2013). A Framework for Learning About Big Data with Mobile Technologies for Democratic Participation: Possibilities, Limitations, and Unanticipated Obstacles. *Technology, Knowledge and Learning*, *18*(3), 103-120.

Slotta, J. D. (2010). Evolving the classrooms of the future: The interplay of pedagogy, technology and community. In K. Makital-Siegl, F. Kaplan, Z. J., & F. F. (Eds.), *Classroom of the Future: Orchestrating collaborative spaces* (pp. 215–242). Rotterdam: Sense.

Slotta, J. D. & Najafi, H. (2013). Supporting Collaborative Knowledge Construction with Web 2.0 Technologies. In *Emerging Technologies for the Classroom: A Learning Sciences Perspective* (N. Lavigne, Ed.). pp. 93-112. Springer.

Slotta, J. D., Tissenbaum, M., & Lui, M. (2013, April). Orchestrating of complex inquiry: three roles for learning analytics in a smart classroom infrastructure. In *Proceedings of the Third International Conference on Learning Analytics and Knowledge* (pp. 270-274). ACM.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. In R. K. Sawyer (Ed.), *Cambridge handbook of the learning sciences* (pp. 409-426). Cambridge, UK: Cambridge University Press.