Scaling Technology-Enhanced Science Curriculum: Leadership Development in a Professional Community

Libby Gerard, Jane Bowyer, Mills College,
Email: lfwg@sbcglobal.net
Marcia Linn, University of California-Berkeley, Berkeley, mclinn@berkeley.edu

Abstract: This three-year longitudinal study reports on a community of principals that supports scaling of technology-enhanced science. Twenty-one principals participated; seven participated in the community and fourteen provided a comparison group. Data include community of principal meetings, interviews and curriculum implementation records. Results describe: (a) shifts in principals' understanding of leadership for technology-enhanced science and (b) changes in numbers of teachers integrating technology-enhanced science over time. Research-based heuristics for developing community for scaling innovation are provided.

We report on the design and impact of a local community of principals who support the implementation and scaling of innovative technology-enhanced science curriculum modules in their schools. Principals play a key role in curricular innovation but rarely have a background in science. We draw on research on teacher communities (Barab, Barnett, & Squire, 2002) and on science learning (Linn, Lee, Tinker, Husic, & Chiu, 2006) to guide our three year long investigation.

We invited all the middle and high school principals from schools participating in a research project investigating the impact of scientific visualizations embedded in inquiry curriculum modules to participate in the principals' community. In the first year we worked intensively with these principals in six states to identify community practices that would help them succeed in integrating this curriculum in their schools. In the second and third years we studied the local community of principals. Principals who chose to actively participate in this local community enticed a larger percentage of their science teachers to implement the science curriculum modules than those who did not participate in the local community.

Many research programs document the challenges of implementing and sustaining use of innovative technology-enhanced materials (Blumenfeld, Fishman, Krajcik & Marx, 2000; Varma, Husic, & Linn, in press). In our research, we created curriculum modules to address topics teachers found (a) difficult for students, (b) aligned with standards, and (c) were likely to benefit from interactive computer visualizations. Results from the first year showed that these curriculum modules improved student understanding of the selected topics (Linn, et al., 2006).

To sustain the success of this curricular innovation, principals need to provide professional support for teachers, acquire and deploy the necessary resources, and determine the role of the curriculum innovation within the school community (Spillane, Diamond, Walker, Halverson & Loyisa, 2001). There is typically little reward, and often considerable risk, for principals who associate themselves with reform. In addition, principals work in professional isolation which makes risk taking more difficult (Elmore, 2000). Professional learning communities have helped teachers improve their practice and overcome isolation (Franke, Carpenter, Levi & Fennema, 2001).

Participants. Twenty-one middle and high school principals participated in this study; seven participated in the community of principals and fourteen provided a comparison group. All participating principals had at least one teacher implementing the technology-enhanced science curriculum at the beginning of this study. Participating principals' schools are extremely diverse including large percentages of students qualifying for free/reduced lunches and are English language learners. In Year 1 we worked intensively with all principals to identify the community practices that support them to lead curricular innovation. In Year 2, we formed a local principals' community by visiting principals (in 2 districts) at their schools and inviting them to spend two-hours, every six weeks in a collegial discussion focused on their issues concerning instruction. This local community of principals continued to meet every six weeks for two years.

Design. This three year longitudinal study examines the design and impact of a local community of principals for scaling technology-enhanced science. Unlike typical district-led professional development which, as one principal in our study described, involves "*going to these meetings where they just give you all these binders and you walk out more overwhelmed than when you came in…*" (MC, Aug 2005), this community was shaped by the participants. For instance during one meeting the principals arranged for one middle and one high school teacher to come and talk about their experiences implementing the technology modules in their science classrooms. During another meeting, principals met at a middle school to observe a technology-enhanced science lesson. Over the two years of community meetings, the facilitator's role declined as principal to principal interaction increased from 43% to over 80% of the meeting talk. In the first year, the community dialogue focused on school goals and the challenges of teaching with technology. In the second year, the group

focused on active gathering and evaluating of information about technology-enhanced instruction and identification of strategies for scaling.

Impact. Principals' regular, voluntary participation in the local community of principals over a three-year period had a significantly positive impact in terms of scaling a technology-enhanced science curriculum, as shown in Figure 1.

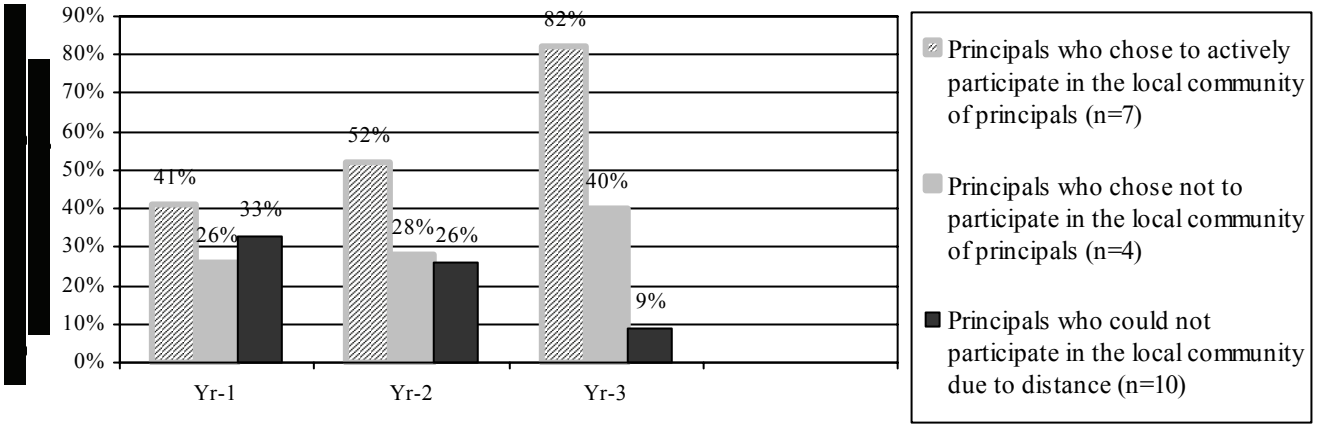

Figure 1. Comparison of the Percentage of Science Teachers using a Technology-Enhnaced Science Curriculum as a Function of their Principal's Participation in a Local Principal Community

The percentage of science teachers using technology-enhanced modules increased significantly (41% to 82%), in comparison to schools whose principals chose not to participate in the local community (26% to 40%). It will be noted that in schools located out of state who could not participate in the community the percentage dropped significantly (33% to 9%). The data suggests that the complexity of implementing technology reform in science requires resources and commitment that depend on the active participation of the school leadership.

Discussion. Scaling depends on the integration of curricular innovation with key school dimensions - culture, capability and policy - so that the innovation becomes a part of a school wide coordinated approach to improve student understanding (Fishman, Marx, Blumenfeld, Krajcik, & Soloway, 2004). Each of these factors impacted success in this study. For example, to increase capability, after learning teachers' challenges implementing a technology science module, one principal arranged for an experienced teacher to have release time from her classroom duties to support novice teachers using a module for the first time. To transform school culture, all principals began to "check-in" regularly with their teachers implementing the modules to show appreciation for their extended efforts and learn their resource needs. To impact school policy, after learning about dynamic visualizations in science learning, two principals joined the district Technology Committee to advocate for integration of technology in district-wide science curriculum.

In summary, a community of principals can support each other to transform their school culture, school capability and school policy to support integration of an innovative science program. Principals who participate also succeed in motivating more teachers to implement the curriculum innovation. Consistent with research on teacher communities, the success of the endeavor depends on willingness of participants to take leadership in their own professional development.

References

Barab, S., Barnett, M. & Squire, K. (2002). Developing an empirical account of a community of practice. Characterizing the essential tensions. *Journal of the Learning Sciences*, *11(4),* 489-542

Blumenfeld, P., Fishman, B., Krajcik, J. & Marx, R. (2000). Creating Usable Innovations in Systematic Reform: Scaling Up Technology-Embedded Project-Based Science in Urban Schools. *Educational Psychology, 35*(3), 149-164.

Elmore, R. (2000). *Building a new structure for school leadership*. Washington D.C.: Albert Shanker Institute

Fishman, B., Marx, R., Blumenfeld, P., Krajcik, P., Soloway, E. (2004) Creating a framework for research on systemic technology innovations. *Journal of the Learning Sciences*, 13(1), 43-76

Franke, M., Carpenter, T., Levi, L. & Fennema, E. (2001). Capturing teacher's generative change: A follow-up study of professional development in mathematics. *American Education Research Journal, 38(3),* 653-689.

Linn, M., Lee, H-S., Tinker, B., Husic, F. & Chiu, J. (2006). Teaching and assessing knowledge integration in science. *Science*, 313

Varma, K., Husic, F., & Linn, M. (in press) Targeted support for using technology-enhanced science modules.