Advancing a Complex Systems Approach to Personalized Learning Communities: Bandwidth, Sightlines, and Teacher Creativity

Eric Hamilton, Pepperdine University, Los Angeles, CA, eric.hamilton@pepperdine.edu

Abstract: Computer-supported collaborative learning (CSCL) has advanced one of the most important visions of educational reformers, to customize formal and informal learning to individuals. And, by its very nature, CSCL promotes connections between learners. A complex systems framework to the design of learning ecologies suggests that each of a series of ten desirable and malleable features stimulates or propels the other ten, interacting to create important emergent properties, such as personalized learning communities or the powerful blending of individualization within community.

Introduction

One of the most recurrent themes in the ascendancy of learning technologies over the past two decades has been the promise to furnish learners with personalized educational experiences (Dede & Barab, 2009; Martinez, 2001). This has been accompanied by recognition that traditional classroom structures, in contrast, reflect a sort of mass production paradigm for education and learning (Weigel, James, & Gardner, 2009). In one of the most famous papers in education research, Bloom asserted a two sigma achievement advantage of one-to-one tutorial instruction over typical classroom teaching (Bloom, 1984). Many explanatory factors have been advanced since publication of the two-sigma paper, including the immediacy of interaction between the student and the teacher and the ability of the teacher to furnish rapid feedback and to size up individualized instructional needs. As internet-based and socially-mediated technologies have given rise to computer-supported collaborative learning (CSCL), designs and affordances for more individualized educational experience have flourished even in contexts that are organized around group activity (Fischer & Scharff, 1998; Stahl, Koschmann, & Suthers, 2006). The expansion of affordances for <u>individualization</u> within technological advances for <u>community</u> implicitly speak to some of the most significant and historically challenging themes of education, of economics, of political systems, and more generally of human and social dynamics, to use a phrase the US National Science Foundation adopted for one if it recent programs (NSF, 2006). The rise of CSCL technologies is dramatically expanding the presence of personalization within community, and the pervasiveness of community within personalization. In education, this means that the collective (e.g., often classroom) experience no longer necessarily eclipses the needs of individual learners as much as in pre-digital formal classroom settings. Effective personalized learning communities routinely give space for individual members to engage in self-directed and personal preference-driven learning while connecting to a group whose identity coheres from the individual activities. Participatory simulations and MUVEs (e.g., Barab & Dede, 2007; Wilensky & Shapiro, 2003) provide two of the most vivid PLC categories. These types of environments are designed to create a community experience out of the individual experience and vice versa.

Personalized Learning Communities Expressed As a Complex Systems Metaphor

This paper explores the possibility of personalized learning communities arising less out of explicit design than out of the interactions of a series of desirable characteristics or "primitives" for learning environments more generally. These characteristics appear in Figure 1. Hamilton and Jago (2010) describe an earlier version of these characteristics and outline a complex systems approach for how the characteristics interact dynamically with each other in one platform to produce higher order emergent effects – high value phenomena in education that are difficult to produce in mechanistic fashion but which represent sublime and high performance experiences for learners. Among such high value phenomena are vibrant personalized learning communities that routinely and expansively reflect and accommodate differences between - and preferences and needs of - its members through the process of immersion in meaningful collaborative experience. One primary rationale for developing a complex systems metaphor is that the salutary elements of Figure 1 seem to feed one another (Hamilton & Jago, 2010). These elements are not meant to be comprehensive nor a uniquely ideal formulation of salutary core elements of effective learning environments. Nor are they mutually exclusive: indeed, in a complex system, these elements overlap each other and became, to varying degrees, mutually implicative. Additionally, they are difficult to measure. Current technologies and metrics are insufficiently advanced to quantify them exactly. Notions of increased **interactional bandwidth** in a classroom, or increased emphasis on conceptual models and **modeling**, while resistant to single metrics, represent important phenomena, and their presence, absence or intensity can be intuitively understood. The value of such a summary partly rests in highlighting ingredients of learning ecologies that play off of each other, that augment each other, and that each is malleable. That is, each can be built into the design of learning experiences. The predictive value of using a complex systems approach is that desirable elements such as those appearing in Figure 1 will increase and

Table 1: Principles for personalized learning communities (adapted from Hamilton and Jago, 2010).

1. **Modeling: Emphasis on models systems thinking and ways to represent connections between ideas. The relationships or operations between ideas becomes as salient as ideas**
2. **Elicitation: Emphasis on students expressing and representing the conceptual systems, intuitions and tacit understanding they already possess. "Draw out of " instead of "put into" the student**
3. **Consequentiality: Emphasis on feedback loops in problem-solving, classroom, virtual world or other settings that are both meaningful to students and that are responsive to them**
4. **Adaptivity: Emphasis on iterative revisions in feedback or consequence-rich settings. Assessment regards improvement and revision processes as important as knowledge snapshots**
5. **Interactional bandwidth: Emphasis on diverse means to express content and meaningful human interaction in the learning environment. Includes: Sightlines or emphasis on creating powerful, diverse, and high-resolution fields of view for everyone in a classroom. Includes visualized representations of both cognition and content**
6. **Customization: Emphasis on matching high-feedback curriculum experience to individuals achievement levels and learning styles. Includes emulating personalized tutorial or mentoring**
7. **Connectedness: Emphasis on socialization including rich, multilayered connections between learners**
8. **Self-regulation: Emphasis on ability to search for and apply new knowledge, manage one's participation in collaborative settings, tolerate ambiguity in unsolved problems, test ideas, reflect deeply on problems and frame intuitions**
9. **Hybrids: Emphasis on diversity of learning modalities and fluid transitions between them, such as between individual reflection and group immersion, between virtual words and real context; interoperability of individuals–social–machine knowledge forms, and heterogeneous competencies**
10. **Generativity: Emphasis on creativity and connections between ideas in problem-solving**

reverberate through the system in ways that can produce emergent effects that resist linear design. The systems model requires different interpretations of cause and effect relationships in learning system design, whereby sometimes causes become effects and vice-versa. It is important to note that each Figure 1 elements represent multiple but related meanings. The notion of "sightlines" for example, or interactional bandwidth more broadly, covers a range of phenomena. Virtual worlds routinely furnish different ways to visualize the properties or elements a real, fictive, or blended environment. Animations generally furnish new ways to see mathematical or scientific structure. A social network map gives a picture of interactions between individuals. Each example represents a distinctive take on increased sightlines in a learning context and the broader notion of increasing its interactional bandwidth. Each of these features represents a rich trove or related meanings that vary in context.

References

Barab, S., & Dede, C. (2007). Games and Immersive Participatory Simulations for Science Education: An Emerging Type of Curricula. *Journal of Science Education and Technology, 16*(1), 1-3.

Bloom, B. (1984). The 2 Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring. *Educational Researcher, 13*(6), 4-16.

Dede, C., & Barab, S. (2009). Emerging Technologies for Learning Science: A Time of Rapid Advances. *Journal of Science Education and Technology, 18*(4), 301-304.

Fischer, G., & Scharff, E. (1998). Learning technologies in support of self-directed learning. *Learning, 98*, 4.

Hamilton, E., & Jago, M. (2010). Towards a Theory of Personalized Learning Communities. In e. (M. Jacobson & R. Reimann (Ed.), *Designs for Learning Environments of the Future* Springer Press.

Martinez, M. (2001). Key design considerations for personalized learning on the web. *Educational Technology & Society, 4*(1), 26-40.

NSF. (2006). *Human and Social Dynamics*. http://www.nsf.gov/pubs/2006/nsf06604/nsf06604.txt: National Science Foundation Publication 06-604.

Stahl, G., Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. *Cambridge handbook of the learning sciences, 2006*.

Weigel, M., James, C., & Gardner, H. (2009). Learning: Peering Backward and Looking Forward in the Digital Era. *International Journal of Learning and Media, 1*(1), 1-18.

Wilensky, U., & Shapiro, B. (2003). *Networked Participatory Simulations: Classroom Collaboration in Exploring the Dynamics of Complex Systems.* Paper presented at the CSCL 2003 (http://www.intermedia.uib.no/cscl/interactiveevents/ia3.cscl), Bergen, Norway.

Acknowledgments

The author expresses appreciation to the National Science Foundation, the Institute for Education Sciences, and the Microsoft Research for generous support of the research reported in this paper.