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# Maximizing Technology's Potential for Facilitating Educational Change: A Response to Sherman and Hicks

JOHN W. SAYE

*Auburn University*

Many teacher educators believe that technology can play an important facilitating role in transforming teaching and learning. I count myself among them. Sherman and Hicks focus on a key factor in tapping the potential of technology as a transforming tool: Teachers must have a vision of the possible. They must see tangible examples of how technology may be seamlessly integrated into subject matter rather than used as a frilly appendage to the real work of instruction.

Sherman and Hicks stimulate our thinking about the roles that virtual reality (VR) might play in promoting such a vision. They provide ample evidence that readily available tools make the construction of simple VR experiences possible for novices. The products that teachers were able to develop in a one-week virtual reality course are commendable. However, I am unsure whether the visions of the possibilities generated from this experience are powerful or convincing enough to plant the seeds that might help to transform teaching and learning.

If technology is to entice teachers to reconsider their practice and help them to empower their students, we must be prudent in how we introduce new technology applications. We should not do technology-based activities simply because it is possible to do so. To demonstrate the power of technology for assisting in the transformation of learning, we must only do those things that we should, not all of the things that we can. How do we decide from all that is possible which things we should pursue? I believe there are at least four interrelated criteria that we should consider in making technology-enhanced curriculum choices: robustness, potential for promoting higher order thinking and disciplined inquiry, potential for expanding the ways that students can gain and demonstrate new understandings, and opportunity cost.

Robustness may be judged by the level of authenticity offered by a technology-enhanced experience. To what degree does the experience enhance our experience of social reality? I remember the first time I viewed a VR site on the web. I had a "Gee whiz!" moment. It amazed me that we could do such a thing so soon in the development of the World Wide Web. But after viewing multiple panoramas, the novelty faded. I wanted it to do more. I wanted to be able to travel into the next room, look out the window, see what was outside and down the street, ask questions of the inhabitants, read the newspaper on the table, and play the phonograph. The panorama quickly became confining. It allowed me to gain a better perspective of the view from where I was virtually standing, but it did not allow me to travel into this world that lay so tantalizingly at my feet.

We can open deeper access to that virtual world for learners, but we can't do it cheaply. Opportunity costs counterbalance the attractions of robustness and potential for inquiry and multiple paths to understanding. Four years ago my research partner and I began developing a multimedia-learning environment for encouraging higher order inquiry in social studies (Saye & Brush, 1999). Our original intent was to build a template and tools that would allow teachers to plug in multimedia content without requiring them to have a great deal of technological expertise. To model the potential of such an environment, we developed a multimedia curriculum database on the African-American Civil Rights Movement. Our work creating the Civil Rights design example confronted us with the reality of the amount of time required to develop a robust product. Time is the teacher's most scarce resource. The creation of robust technology-enhanced products may require more of teachers' time than is feasible. We believe that our learning environment is an example of such a case. I suggest that virtual reality presents the same challenge. VR has great potential for robustness, but such potential is unlikely to be realized if the teacher is the chief engineer.

In addition to providing a robust experience with rich resources, technology-enhanced curriculum experiences should seek powerful learning outcomes. The opportunity costs involved in its production are too high for trivial results. If the same goals could be accomplished in more cost-effective ways, we should probably forego time-intensive technology enhancements of an experience.

The teachers' projects presented in this paper feature some powerful goals for historical analysis and narrative construction. However, these goals seem overly ambitious in light of project content. Constructing historical narratives involves reconfiguring historical documents into a plot (Holt, 1990). Rigorous historical analysis is likely to require richer data resources and more support for student inquiry than are featured in the project VR environments. Furthermore, most projects do not use technology to allow students to represent their understandings in alternative ways. Students are most often asked to write a narrative or a journal entry. The "Pieces of the Past" project does require students to compose their own VR web site, but the sites are to be descriptive, not analytical or evaluative.

I do not intend this as an indictment of the teachers' efforts. The authors acknowledge limitations due to the compressed course time frame. Conceptualizing and developing quality, higher order learning commonly takes longer than was available. Furthermore, the course goals and assessment criteria seem open-ended enough to make familiar, lower-order tasks acceptable for meeting course requirements. The research on teacher change strongly suggests that most individuals feel uncomfortable with the unfamiliar and tend to co-opt an innovation to fit established ways of doing things (e.g., Cohen, 1988). If we are to leverage technology to help transform teaching and learning, we need to present teachers with a more powerful charge, give them rich visions of what is possible, and provide them with adequate time and support to create robust experiences.

What types of experiences would represent robust uses of virtual reality for social studies? We need applications that tap into the potential of VR to immerse us in a more holistic experience with social reality. In most cases that is likely to mean virtual reality is but one media element in a range of integrated multimedia. For instance, the Nova pyramid tour uses scenes to go beyond a simple panorama and take us deeper into the pyramid (<http://www.pbs.org/wgbh/nova/pyramid/explore/khufuall.html>). However, it would be a much more holistic, genuine experience if it also had contextualizing elements such as the street sounds and oral history available in the visit to a 1930s tenement

(<http://www.pbs.org/wnet/newyork/hidden/contents.html>). Conversely, the world of the tenement dweller would become more real with the integration of linked panoramas.

Robust integrated learning experiences that tap the potential of virtual reality may use only simple panoramas. However, those panoramas would be used in conjunction with other instructional elements to encourage complex learning such as disciplined inquiry and historical thinking. For example, an interactive lecture format that uses still and moving images, audio, primary accounts, period documents and artifacts, and role-playing to complement framing teacher narrative and questioning can immerse students in the historical surround of a period while providing support for inquiry and historical empathy. The addition of VR panoramas at appropriate intervals in this instructional interaction could enrich the learning experience.

More robust uses would link media elements into more authentic virtual worlds. Richly featured simulations and situation explorations that place students in authentic problem-based scenarios are likely to represent the most robust uses. The problem might be couched within a historical mystery such as the non-VR experience featured at <http://web.uvic.ca/history-robinson/index.html>. As in the Robinson scenario, learners would search the site for historical evidence and make sense of data. Virtual reality could be used to link data such as primary documents, personal accounts, and testimony or interviews with historical figures within a spatial context that enhances the experience of place and time.

Multimedia simulations or situation explorations that include virtual reality might bring learners into closer proximity with the complex dimensions of an historical figure's world as that person is confronted with a dilemma that must be resolved. Part of the challenge for novices in understanding a complex problem is looking beyond the surface dimensions of a situation to grasp the third dimension of the problem landscape, the abstract structural components that are embedded in the case (Spiro & Jehng, 1990). By virtually traveling into the world of the historical figure, learners might encounter other contexts and perspectives that deepen their understanding of the issue within its historical setting. For instance, a number of virtual settings might be integrated within a larger scenario investigating the role of antiwar protest in the outcome of the Vietnam War. In one setting, a learner trying to decide whether the Chicago Seven should be indicted for actions taken during the 1968 Democratic Convention might view the situation from the perspective of a reporter based in a hotel room at Chicago's Conrad Hilton. With the reporter, students could look out on Grant Park, travel through the scene of the demonstrations and inside the convention hall, encounter (through a period video clip) police attacking the protesters, hear a speech by Mayor Richard Daley, read a newspaper editorial judging the event, and view television coverage of the Vietnam War.

Developing such complex products requires a great deal of time and expertise, but it is the experiences offered by these types of technology-enhanced curricula that are worth the opportunity cost. In concluding their article, Sherman and Hicks emphasize the need for teacher education institutions to build networks to support the efforts made by teachers to integrate technology into their classrooms. Such networks are essential if transforming applications of technology are to be developed and adopted by the nation's teachers. Teachers often will not have the technological expertise to develop complex technology applications, nor will they have the time to invest acquiring such expertise. However, teachers have a deep understanding of students and classrooms that are vital to designing workable technology-enhanced curricula.

Colleges and universities should work with teachers to form curriculum development partnerships. The summer course by Sullivan and Hicks might represent the beginning of such a

partnership. Teachers would join with instructional technologists and content area teacher educators in an intensive summer institute designed to introduce the vision of technology's potential and brainstorm powerful curriculum projects. The group might narrow those choices down to several projects on which development teams of teacher educators and teachers would focus over the course of the next school year. Another intensive summer institute the following summer might be devoted to final production of the multimedia-supported learning environments. Ideally, such partnerships would continue over the long-term with field tests and continuing refinement of curricula. Developing and maintaining such intensive partnerships will not be easy. However, without robust, integrated learning environments developed through the involvement of all stakeholders, the potential of technology-enhanced instruction as a catalyst for transforming teaching and learning is not likely to be realized.

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