TAPPING INTO ACTIVE LEARNING AND MULTIPLE INTELLIGENCES WITH INTERACTIVE MULTIMEDIA

A LOW-THRESHOLD CLASSROOM APPROACH

Tom Schrand

Abstract. Educational technology is seldom used to facilitate more active student learning in the classroom. Instructors who have mastered PowerPoint, however, could just as easily learn to create simple pieces of interactive multimedia that encourage student participation in learning tasks and that appeal to multiple intelligences and learning styles. Macromedia Flash animation projects can be used to increase student engagement and to activate peer learning. New multimedia authoring software can create opportunities for effective student-centered learning that were not previously possible.

Keywords: *active learning, educational technology, learning styles, multimedia, multiple intelligences*

Since the beginning of the digital age, the evangelists of educational technology (myself included) have expected computers to revolutionize teaching and learning. Common predictions for the future have included the belief that distance learning will increasingly replace face-to-face instruction, that digital technology will allow education to be increasingly customized to the needs of the learner, and that learning will become increasingly efficient and accessible (Taylor and Schmidtlein 2000). A 1998 report by Coopers and Lybrand suggested that the advent of distance learning and other digital innovations might be pushing the education field to "the verge of a transformation similar to what has occurred in the health care industry over the past decade" (Diedrich 1998).

Despite these dramatic predictions, however, our universities still retain their familiar appearances and the dynamics of student learning in the typical university classroom remain largely prerevolutionary: students do (or do not do) the assigned readings, the instructor lectures or leads discussions, and students take tests or submit papers. Our classrooms now often have LCD projectors with computers attached, but these tools are usually at the service of the instructors, who use them primarily to outline and illustrate their lectures. In terms of applying new technologies in the classroom environment, we instructors are still largely in the "shovelware" mode, in which we use new digital formats like presentation software and course management systems primarily to repackage our predigital course materials and our traditional pedagogies of passive student learning (Fraser 1999). With a few exceptions, dimming the lights for our next PowerPoint presentation also means turning our backs on active or student-centered learning.

Thanks to the scholarship of teaching and learning, however, we are increasingly aware of the gap that separates the "shovelware" approach from modes of learning that have been proven to be more effective (Prince 2004). This research encourages us to avoid using new technologies as shovels and, instead, to use them to build structures for active forms of student learning that were not possible

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or practical with our previous technologies. This article will examine two in-class applications of instructional technology that, although more primitive than revolutionary, suggest that multimedia animation software can help us replace "shovelware" with computer-based activities that allow students to own their learning and to collaborate in authentic and productive ways in the classroom. In fact, the rudimentary nature of these two examples may be their most promising characteristic: multimedia exercises based on sound principles of active student learning can be created with approximately the same level of technical expertise that it takes to master PowerPoint or Blackboard.

From Chalkboard to Animation

As multimedia programming software became more accessible and multifunctional in the late 1990s, I began to wonder whether interactive animations could be used to promote active learning and to accommodate more visual and experiential styles of learning. After completing several summer courses in Web design and multimedia programming at my university, I did not become a professional instructional technologist, but I did expand the kit of digital tools that I could bring to the courses I teach. Initially, I found the multimedia courses somewhat discouraging, as I realized that the types of elaborate instructional programs that I had envisioned would require much more time and coding expertise than I could ever hope to muster as a full-time professor. As I returned to the day-to-day challenges of the classroom, however, I sometimes wanted to develop active learning exercises with some kind of visual, interactive dimension. These were not intended to be full-blown learning modules, but rather simple in-class group exercises centered on the class material for that day. On a few of these occasions, I realized that an animation program like Macromedia Flash could do what I had in mind, but it would be such a simple application of the software's powerful capabilities that I was almost reluctant to use it. In both of the cases discussed in this article, the multimedia animation was limited to creating simple graphic elements, such as labeled boxes, block arrows, or even plain typed phrases, that could be clicked on with a mouse, then dragged and dropped somewhere else on the screen. This kind of interactivity is one of the simplest functions possible, something that you would learn in the first week of a multimedia class or that you could teach yourself in several hours with a software manual. Even at this basic level, however, I was able to create something for my students that more familiar software like PowerPoint or Blackboard could not have provided: a communal work space, a learning field that could be projected onto a screen in the classroom in real time for everyone to see and, just as important, for everyone to use.

In the first instance, I was teaching a senior capstone course on global issues, which included a unit on intercultural understanding. For several semesters, I had been using an in-class exercise that required small groups of students to sort through slips of paper that had short phrases on them, each representing a different cultural value (Kohls and Knight 1994). The goal of the exercise was to divide these values into two categories: those that seemed characteristic of U.S. society and those that did not. Within the small groups, this task usually generated lively discussions as the students examined U.S. cultural values and reflected on which ones seemed to be excluded from U.S. society (each value had a contrasting alternative, so choosing one for the United States normally required rejecting the opposing value). I had always appreciated this exercise as a means of helping students see that U.S. society was shaped by a very specific constellation of values, and that embracing this particular set of values required discounting alternative values that might be considered just as desirable. The small groups always worked well on this task, but when the time came for the groups to share their conclusions, it was difficult to display or report everything they had decided (the exercise involved twenty-six different values). Normally, I would use the chalkboard, and we would try to reach some kind of group consensus about which values belonged where, but this involved a lot of scribbling and erasing as the groups tried to convince each other of the correctness of their conclusions.

So, my decision to digitize and animate this exercise was initially intended to streamline it: I wanted to display the groups' decisions without having to write all twenty-six phrases by hand and then erase and rewrite them as the class discussion continued. Displaying the values on a screen had the added benefit of making all twenty-six values visible and available at once, rather than adding them to the chalkboard one at a time and having to rely on the slips of paper on the students' desks as a reference (figure 1). The new animated exercise started with all of the values displayed in one middle column, with empty columns on either side for U.S. values and non-U.S. values.

When the computer cursor moved over a phrase, the cursor arrow turned into the pointing hand icon that indicates something on which you can click. When a phrase had been clicked on, it could then be dragged to another part of the screen and dropped by releasing the mouse button. The result was an interactive screen with twenty-six elements that could be moved around fluidly and rearranged at will (figure 2).

Once I had created this multimedia piece, I realized that it was now so easy to manipulate the items that I did not have to do it myself. I decided that when the small groups had finished their work (the slips of paper would still be necessary for the first part, since students did not usually have computers at their desks), I could turn the computer podium over to them. To spread out the work, I asked each group to put five or six values in the columns that they thought were correct, and the groups took turns until all of the values had been moved into a column. Then, to emphasize their participation in peer learning, I gave the groups a second round of turns, and asked them to correct what they saw as the mistakes of the first round. This step generated a sense of good-natured competition that almost always triggered vigorous student discussions about the cultural topics we were examining.

My second example comes from an introductory world history class, in a unit on the industrial revolution. One of the objectives of this first-year course is to help students develop their critical-thinking skills, and for this particular topic, we were working on cause-and-effect relationships. The beginnings of the industrial revolution in Europe offer a rich opportunity to practice this type of analysis: not only is it necessary to understand

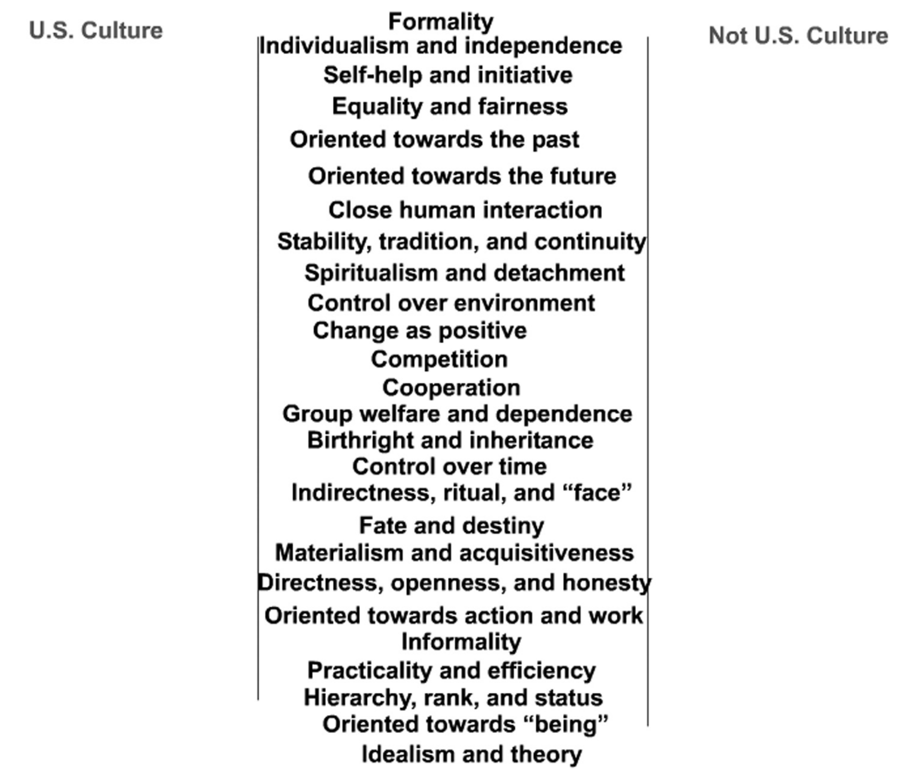

FIGURE 1. The beginning of cultural values exercise.

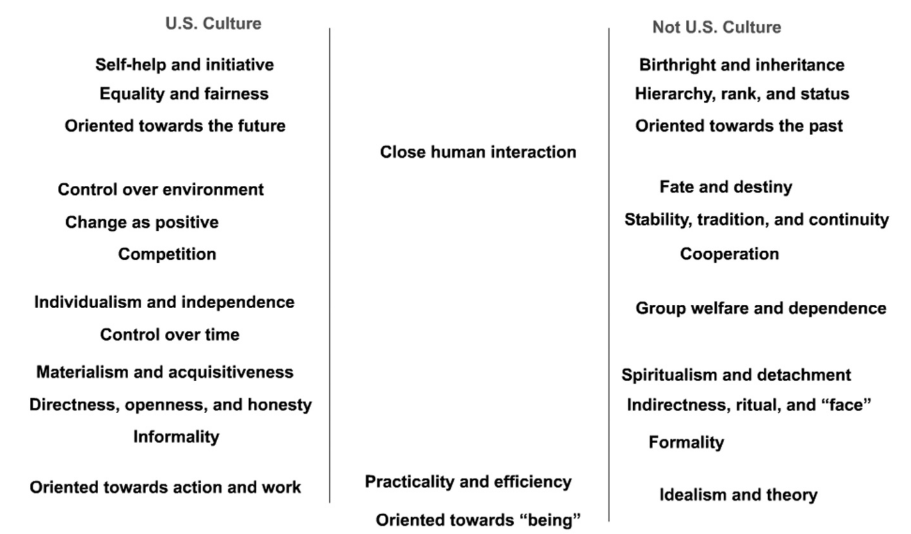

FIGURE 2. Sample completion of cultural values exercise.

how technological breakthroughs in one area of production led to bottlenecks, positive feedback loops, and additional innovations in other areas, but it can also be applied to the scholarly controversies about whether the revolution was triggered by technological advances or whether broader social, political, and economic changes created conditions conducive to the application of new or existing technologies. One strategy I have used to help clarify these complex chains of cause and effect is to develop flowcharts that illustrate the relationships between different trends, events, and innovations in the industrial revolution. Initially I developed these for myself to use in lectures, but eventually I began requiring students to develop their own flowcharts. To make this an active learning collaborative exercise, I even created in-class group assignments where students were given construction-paper arrows, transparent tape, and pieces of paper with relevant industrial revolution topics printed on them. The groups were then asked to assemble flowcharts on the classroom walls, which we were able to inspect and critique.

Here, too, the headaches of working with scraps of paper and the difficulties of displaying a class consensus reduced the pedagogical effectiveness of the exercise. Once again, I turned to interactive multimedia to develop a more streamlined approach. Using the animation software, I created an exercise in which all of the moving parts were digital and programmed to be dragged and dropped on the computer screen. In this case, I simply designed text boxes for about twenty different trends, inventions, and consequences, all taken from our textbook's explanation of the industrial revolution and displayed in a random order. Then I added an ample supply of arrows, which could be moved around and placed to indicate cause-and-effect connections (figure 3).

As a homework assignment before the in-class exercise, I gave students a list of the different items and asked them to draw their own flowcharts. When they came to class, I organized them into groups, had them share their flowcharts with their group mates, and then asked one group at a time to come to the computer to begin organizing the items and arrows into a pattern that reflected their understanding of the causal relationships in the industrial revolution (figure 4). Each group got a turn to contribute to the arrangement, while the others watched the process on the projector screen.

Once the groups had all taken their turns, they were offered a second chance to alter elements of the chart that they did not find convincing. As with the cultural values chart, this activity produced a lively group discussion and allowed students to challenge each other's explanations as they worked together to complete an analytical task.

THE PRINCIPLE OF PROMPT FEEDBACK MAY BE LESS APPARENT IN THIS SITUATION, BUT THE VISUAL DISPLAY OF EACH GROUP'S WORK ON THE PROJECTOR SCREEN PROVOKED IMMEDIATE EVALUATION AND RESPONSE FROM CLASSMATES, FOLLOWED BY DISCUSSION OF CONTESTED POINTS.

New Media and New Possibilities in the Classroom

In both of these cases, the use of simple interactive multimedia created a classroom dynamic that I had rarely experienced and that might not have been possible without the digital dimension. Students not only showed a high level of engagement in the activities, but they also communicated and shared knowledge in a more spontaneous and authentic way than they had in any other kind of active-learning exercise. Noticing this unusual level of student-student interaction, I realized that these multimedia pieces created a set of conditions that are not often available in the classroom: students had been given an object to be manipulated, a task to be completed, and a public visual space in which they could track each other's work as they collaborated, questioned, and explained their conclusions. Once I created and presented these pieces, I could focus my teaching efforts on observing (and perhaps moderating) the student-student interaction and on debriefing the class at the end of the exercise. At the end of the exercises, the final student product was clearly displayed on the projector screen, and with a simple screen capture, I could copy the results and distribute them by e-mail or post them on the class Web site.

Because the student response to these pieces differed from any previous experience I had either with active learning exercises or with the in-class use of computer technology, I became curious about what exactly was happening pedagogically during these activities and what broader lessons they might have for student learning. What made these computer-based exercises more engaging and productive of student-student interaction than other active learning activities? Most of the scholarship examining the intersection of active learning and educational technology is focused on formal assignments completed outside of the classroom (Abrami 2001; Bass and Rosenzweig 2001; Sabri and Baldwin 2003). Due to the scarcity of research regarding in-class active learning exercises based on digital media, I began my analysis by referring to the seven broad pedagogical principles outlined by Chickering and Gamson (1987). Their recommendations for good practice in undergraduate education include at least five principles that appear relevant to this case: reciprocity and cooperation among students, respect for diverse talents and ways of learning, active learning, prompt feedback, and time on task (Chickering and Gamson).

The productivity and authenticity of the student-student interactions are what first struck me about these in-class exercises, which led me to Chickering and Gamson's (1987) principle of reciprocity and cooperation among students. The learning dynamic identified with this principle corresponds to what multiple intelligence (MI) theory calls "interpersonal intelligence," a facility for learning "through sharing, comparing and relating with others, interviewing, and cooperating" (Denig 2004). These exercises had social dimensions with two different scopes: small-group collaborative work and whole-class discussions in which the groups shared, compared, and debated their results. The use of interactive multimedia and computer projectors greatly facilitated the sharing element, providing a platform on which students could visually display their results and organize the process of discussion and negotiation toward consensus. The social nature of the exercises would also engage what MI theory refers

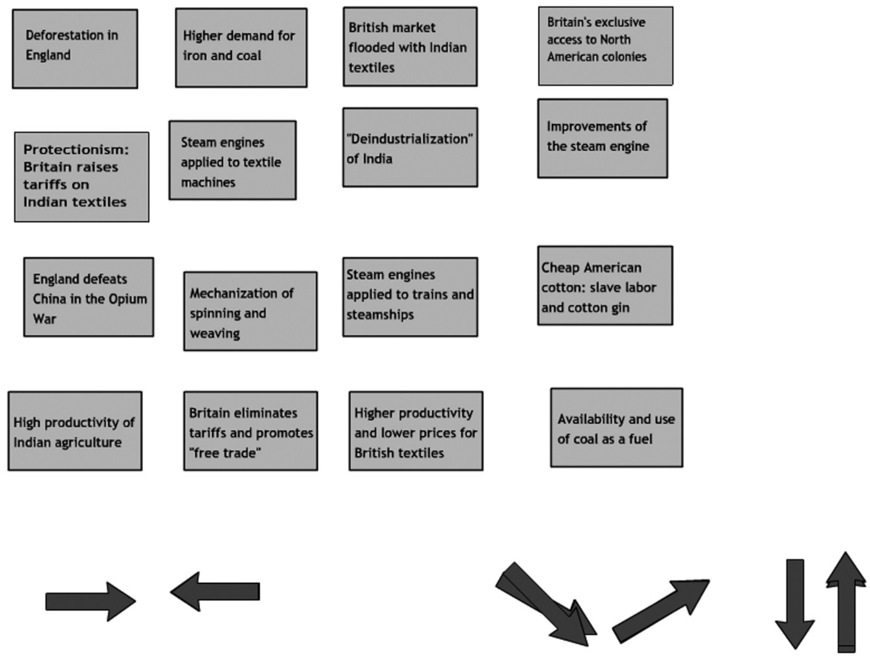

FIGURE 3. The beginning of Industrial Revolution flowchart exercise.

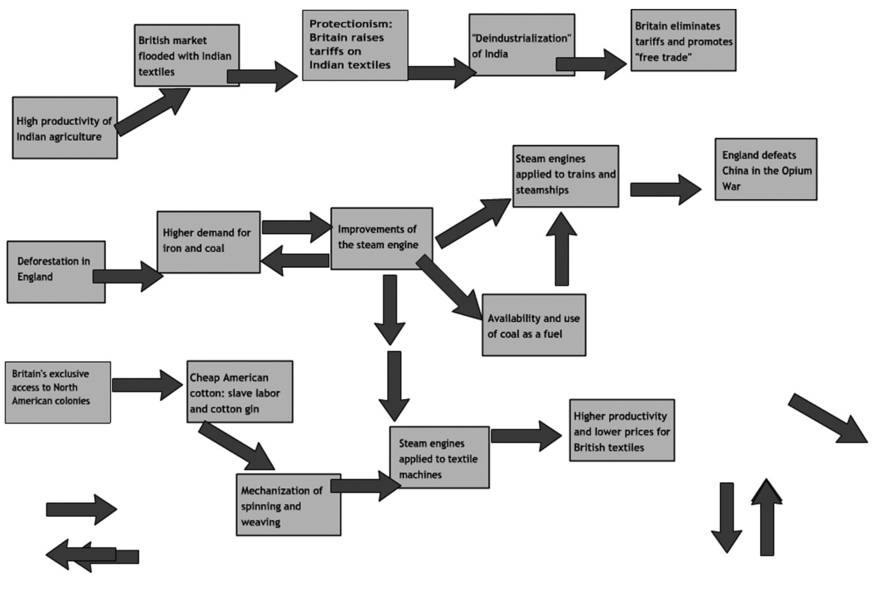

FIGURE 4. Sample completion of Industrial Revolution flowchart exercise.

to as linguistic intelligence, as students applied their oral communication skills to offer and debate different explanations of the course material.

By providing students with a clearly defined task, these exercises seemed to give their interactions a level of engagement and motivation that is often lacking during in-class group work. Because of their visual and technological nature, the tasks assigned to the students had characteristics that would correspond to several of the other capabilities identified in MI theory, which brings us to another Chickering and Gamson (1987) principle: respect for diverse talents and ways of learning. For example, the task of bringing order to the disordered terms and concepts might appeal to students oriented toward the MI category known as logical-mathematical intelligence. Spatially intelligent students (our university offers a large number of majors in various design and architecture fields) would be drawn to the visual aspects of the activities, which required manipulating the animation objects in a two-dimensional space to produce a coherent visual representation of the students' understanding of the topics. Those oriented toward bodily kinesthetic intelligence could benefit from the opportunity to move objects in a virtual space, using this physical activity to fulfill the active learning assignment (they also have the opportunity to move about the classroom, as they switch between the roles of performer and critic/commentator). Even the names of the main animation commands used in these pieces, "drag" and "drop," indicate physical actions. In the course of these activities, some students showed an impulse to organize the screen, aligning and adjusting the various icons to make them more orderly, after other students had moved them around and dropped them in a more casual manner. This urge toward order and alignment may have been the result of a strong sense of visual composition (spatial intelligence) or simply a response to the ease and fluidity with which the animated Flash objects respond when they are selected on the screen (bodily kinesthetic intelligence). In any case, the ability to interact easily and intuitively with these learning objects seems to appeal to a wide variety of learners.

The next relevant principle, active learning, was my original impetus for designing these multimedia pieces. Because of many proven advantages of active, student-centered learning strategies, I intended these exercises to give students the leading role in making meaning from the course materials and intentionally designed myself out of the "sage on the stage" role (Prince 2004). The literature on active learning describes it as having the following characteristics: emphasizing skill development over information transmission, involving the use of higher-order thinking, having students engage in activities, and encouraging student exploration (Bonnell and Eison 1991). In this case, students were assigned clear analytical tasks to complete and were provided with a public digital stage on which to display the results of their work. The exercise invited them not only to explore class topics and to create meaning for themselves in a low-stakes setting, but also to display and explain their conclusions, to review the thinking of their classmates in other groups, and to work together to reach some kind of consensus about their understanding of the course material. The visual, public display of the ongoing work created a feedback loop of active learning that could only end when everyone was satisfied with its outcome. By taking control of the mouse and the computer podium, the students symbolically, literally, and kinesthetically assumed the active role in the classroom, taking responsibility for their own learning.

The principle of prompt feedback may be less apparent in this situation, but the visual display of each group's work on the projector screen provoked immediate evaluation and response from classmates, followed by discussion of contested points. At the end of the class, the final results were visible to all, which made it easy for me to debrief the class, to comment on the outcome of the students' work, and even to save the final visual product for further discussion or individual analysis. In this case, the feedback was formative, rather than summative; the exercises were low-stakes activities designed to help students practice analytical skills that would be evaluated more formally in future assignments. The sense of play and group competition that developed may also account for the high level of engagement that the students showed in these activities and suggests some parallels between these learning exercises and multimedia computer and video games. As scholars like Michele D. Dickey (2005) and James Paul Gee (2003) have suggested, instructional designers may benefit from studying and adapting the strategies that game designers use to increase player engagement. Maximizing engagement, according to researchers, involves feedback-related factors such as game play that reduce the consequences of mistakes or risk taking (Dickey). Using an informal, low-stakes style of assessment, my in-class multimedia exercises provided this type of more lenient formative environment, which Gee identifies with the "psychosocial moratorium" concept of psychologist Erik Erickson. Scholarship aimed at identifying the characteristics of engaged classroom learning focuses on additional elements that could also be used to describe my multimedia in-class activities: a collaborative approach to learning; performance-based assessment; generative learning; students taking the roles of explorer, teacher, and producer; and instructors in the roles of facilitator, guide, and co-learner (Jones et al. 1994).

These interactive exercises can also be seen as promoting one final characteristic from Chickering and Gamson's (1987) list: time on task. Here, the focus is not on the total amount of time devoted to the group work—the predigital versions of the activities took as long as the digital versions—but, rather, on how much time is devoted to what kinds of intellectual tasks. In the predigital versions, a certain amount of time was devoted to the students' paper shuffling or to my chalkboard scribbling. The small-group work was relatively productive, but the reporting out to the rest of the class became awkward, and in terms of learning, we were fumbling an important transition. If we use the familiar categories of Bloom's taxonomy, the initial small-group work could be identified at the cognitive level of "analysis," as students attempted to categorize concepts or establish connections. When it came time to report and defend their conclusions, the students were raising their cognitive work to the higher level of "evaluation." The ease with which the digitized exercises allowed them to share and edit the results of their small-group work meant that the class was spending more time working at this higher cognitive level, and that they could follow the progress of the work in a clearly understood visual display.

In both of these classroom examples, inviting students to manipulate interactive multimedia pieces, displayed on a large screen, triggered a level of in-class active learning along the student-student axis that probably could not have been achieved without digital technology. All of the factors that contributed to the lively classroom dynamic—the widespread participation, the element of play, the sense of student ownership, and the visual, public display of student performance—were enhanced by, or entirely dependent on, the technological platform. The digital medium created a set of possibilities that did not exist before, facilitating a type of active student learning with public, visual, and kinesthetic properties that crossed the boundaries of multiple intelligences.

Conclusion

Multimedia animation design, of course, is not currently a common skill among university faculty, but the ability to use a product like Microsoft PowerPoint, which can often reinforce a passive style of learning, has become almost universal. Conceivably, in the same time it takes a faculty member to learn how to design PowerPoint presentations, he or she could be taught the rudimentary multimedia skills necessary to create the kind of materials used in these exercises. Which types of software our universities choose to provide and promote and our faculty choose to master has a great deal of influence on what type of student learning will occur in our classrooms. As we try to move beyond the "shovelware" phase, perhaps one solution is to supplement our PowerPoint and Blackboard shovels with additional tools that are not designed for scooping and dumping. We can also do more to put these new tools in the hands of students, or, when appropriate, let them work with well-designed "games" instead, where they can experience the sense of discovery and play that often accompanies meaningful learning.

A colleague of mine suggested that a class session organized around the kind of multimedia exercises described in this article might be more similar to a studio class than a seminar. Whether for a performing art like dance or a professional field like architecture, the studio model suggests students engaged in activity, often collaboratively, as they practice, build, and create. Using multimedia animation to structure at least some of our class sessions each semester according to this studio model seems like a natural way to promote active learning and to allow students to practice, in a low-stakes setting, the kinds of skills and critical analysis that we want them to master. For digital technology to transform education in the ways that have been anticipated, instructors will need to continue to think creatively about what we can do now that was not previously possible and how that can be applied to help students learn in active and effective ways. Interactivity and highly visible public display are two characteristics of the new multimedia especially well-suited for active, collaborative student-centered learning that spans multiple intelligences. Over time, the textbook and software companies will begin to offer us more and more of these multimedia educational materials, but that does not mean we have to wait. Just as the advent of technologies like the word processor, the Internet, and the photocopying machine gave individual instructors the power to create, assemble, and distribute custom materials for their classes in ways that were previously accessible only to professional publishers, current multimedia software programs are giving each of us the power to create low-threshold animations customized for our own classes and for the active learning of our students.

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