

New Media's Impact on Education Strategies

Woodie Flowers

Fictitious events and scenarios are used in this chapter to help the reader visualize changes in education. Most sections open with fanciful stories.

The term “new media” is used throughout the chapter. This phrase was chosen to try to avoid confusion. It does not mean distance learning or videotaped lectures. New media refers to a high-tech way of doing what textbooks are supposed to do. These new media materials are assumed to be part of a continuously improving *service* that includes automated homework and quiz evaluations.

Early in the chapter several examples are used to support the author's contention that we are not effectively guiding students to learn. No effort is made to present a summary of the literature on the state of education. The examples are primarily drawn from the author's experience.

HIGHER EDUCATION should have a larger positive influence. A change in the basic vehicle used for learning, from archetypical courses, lectures and textbooks to interactive electronically portable media, could be the seed for positive change in our entire education system. These new media learning materials could enhance the academy's contribution to society by improving learning efficiency and expanding higher education's impact. Both the quantity and quality of learning could increase.

Properly designed new media materials can improve K–12, residential, distance, and life-long learning. In their highly developed form, these learning materials would be as elegantly produced as movies and video games and would be as engaging as a great novel. They would be “smart” to both accommodate the learners' varied styles and yield data to facilitate their continuous improvement. Very popular and required topics provide the most attractive initial opportunities. For example, codified knowledge such as calculus or foreign languages would be most easily adapted to semi-automated training systems.

The current “course” model of learning exemplified by isolated teachers and groups of students does not lead toward the systemic changes higher education needs. New media provides an opportunity for universities and colleges to take a fresh look at designing a better educational experience. Residential programs, for instance, probably should focus on the educational activities that require residence or presence.

A Fresh Perspective

The flying saucer lands. Nervously, the wide-eyed professor approaches the saucer. To his astonishment, as the alien walks down the ramp, her first remark is, "Take me to your university."

Suddenly Professor Eslie finds himself in a position to teach a whole race of beings about how we educate young adults. Ms. Alien is quite smart and easily understands English. She has done her homework and is loaded with questions.

She first asks, "What are your goals for this university education?"

Prof. "We think a university education has three major components. We must train students so that they have adequate knowledge; we must educate them so that they can think critically and grow; and we must provide an environment conducive to their maturation."

Alien "Great. That sounds reasonable. Could you please give me a tour of your university and show me how you accomplish these goals?"

Prof. "I'd be happy to. Let's begin with the largest building on campus. Behold our new football stadium!"

Alien "And what goal does this serve?"

Prof. "Well it's sort of hard to explain. Let's go watch. A game is in progress."

Alien "Wow! This is really big! There must be 75,000 humans here. They all seemed to be focused on those groups down

there crashing into each other. It appears that some of the humans have been chosen to dance along the edges of the arena and incite the others with shouts of ‘fight’ and ‘kill.’ This is very curious. Can you please explain again how this is related to your three goals?”

Prof. “Well, the connection is rather indirect, I guess. You see, our young adults come here for a bonding experience. Our alumni feel proud of ‘their’ team. In fact, our culture is obsessed with this stuff. Most of the media and news coverage about our school is actually about our sports teams. No one is really interested in the academic part of the university. The giant billboards on the highways into town show our sports schedules, not our class schedules. Nobel Prizes do not matter compared to a national football championship. The person who teaches the students to crash into each other gets more money and fame than our chief academic officer.”

Alien “This seems like a huge distraction. On Monday morning, could we go see things more directly related to your goals?”

Jump to Monday morning:

Prof. “Ms. Alien, here in this huge, beautiful new lecture hall you will see one of our most famous professors educating our students. There’s plenty of room. Let’s take a seat.”

Alien “Even with my extraordinary vision and hearing, I’m having trouble understanding your famous professor. He seems to be whispering to the wall. Also, what he is writing

on the black rock with the white rock is very hard to see and follows no rational pattern that one can detect.”

Prof. “Maybe not, but he is very famous!”

Alien “Only about 1/3 of the 300 seats available are taken. Should other students be here too?”

Prof. “Well, actually, most students don’t attend lectures. We don’t understand why, but they miss a chance to be educated by one of the world’s greatest.”

Alien “But the ones who are in attendance are simply writing down selected portions of what the famous professor says. How again is that related to education? Or, is this supposed to be training?”

Prof. “Maybe. This is a first-year course. Let’s look in on another class. Look in here! These seniors are getting some serious education!”

Alien “They are all very quiet and are filling in little squares with black markers. What are they learning?”

Prof. “Oh, this is a test. If they do well on these tests they can graduate and become professionals.”

Alien “So is that what professionals do, fill in little squares with black markers?”

Prof. “Well, not exactly, but we think if they can fill in the right squares, they will be good in their professions.”

Alien “That’s odd.”

Prof. “Perhaps we should visit the place the students live. There you will be able to see how they learn. This, Ms. Alien, is Omega Omega Omega, one of our oldest fraternities.”

Alien “I hear very loud rhythmic sounds. My olfactory sensors

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detect alcohol. Is this part of the environment you've chosen for the students' maturation?"

Prof. "Actually, we know that this is not an ideal environment, but if we do not allow students to participate in this ritual, they riot!"

Alien "Can we get back to the big picture? What percentage of your young people attends college?"

Prof. "In this country, two of every three start college after high school. Some cannot afford it and some are too poorly prepared."

Alien "And what percentage complete a degree?"

Prof. "Unfortunately, about one-half drop out. But this country does much better than the worldwide average!"

Alien "Have you initiated changes to correct these serious problems?"

Prof. "Yes! We have launched a \$2.2 billion Capital Campaign. Uh, that means we are begging for more money."

Alien "I must confess, Professor, that I'm quite confused by your university system. Perhaps it is because I come from another culture, but I am unable to see a correlation between your goals and what you have the students doing. Maybe as your technology advances, you will develop improvements. I have other planets to visit. Thanks for the tour."

The above scenario is meant only to point out that we probably do have room for improvement. Is education shaping society as it should? For students, is learning as exciting as it can

be? Is a typical freshman year a well-designed maturation experience? For residential students, is it a requirement that they be in residence? Do our measures of students' ability relate well to their skill as professionals? Are our prices reasonable?

On a worldwide scale, things are in tough shape. Sir John Daniel points out some of the problems. Half of the world's population is under age 20, and we essentially have no chance of educating the population by "conventional" means. We have neither the personnel nor the facilities. Should we change or just continue to educate the privileged few? His view is clear:

"Our traditional concept of the campus university will deny higher education to nearly all these young people. Yet providing them with education and training is not just a pressing issue for the countries concerned. This is a time bomb ticking under our collective security. Without vigorous action, many of these young people will grow up to be unemployed, unconnected, and unstable. In a global world, that is a global problem. We require mass training for employability and mass education to inspire the human spirit."¹

Given recent events, Sir Daniel's wisdom is hard to ignore.

In the United States the education industry is quite large, on the order of \$700 billion. Is that money spent efficiently? Does our culture reflect the influence of such a large budget? Pardon my pessimism, but a very long list of education-related fixable maladies surround us. Our addiction to violence as entertainment is an obvious absurdity. The general lack of scien-

tific literacy is frightening. Each of us could make a long list of issues that warrant critical thinking but just are not getting it. It seems that we educators are not influential enough.

Can we do better? Can new media help? I think, “Yes.”

Why Change and Why Use New Media?

Sir John Daniel’s arguments are powerful, but personal experiences as a teacher initiated my anxiety about the need for change in education. Experiments conducted by colleagues convinced me that new media can help.

Are We Doing Even the Easiest Jobs Well?

My shorthand for the three goals proposed by the fictitious Professor Esleie is that students should become facile at *informed creative thinking*. Let’s consider *informed*.

Informed seems to be the low-hanging fruit. To become “informed” is mostly equivalent to being trained. Training people seems easy compared to educating people, yet in practice it proves difficult.

Years ago I became alarmed about students’ apparent lack of understanding of engineering principals. Faculty in mechanical engineering at MIT developed a mantra: “Didn’t you get that last year?” We were repeatedly amazed that our students did not know material from prerequisite classes. We concluded that students apparently learned nothing in high school. As we

complained, I think we all thought that someone else was causing these problems. I must confess that now I think that I am part of the problem, too. If we had Bad Teachers Anonymous, I would stand and say, "My name is Woodie Flowers and I am a bad teacher." To make my point, I cite studies very close to home.

In the early 1990's, I was a member of Dr. Crispin Miller's doctoral committee. Dr. Miller received his Ph.D. in mechanical engineering. In his dissertation, "So Can You Build One? Learning Through Designing: Connecting Theory with Hardware in Engineering Education," Dr. Miller painted a disturbing picture of abstract concepts dancing in students' heads.² In his abstract he said,

"... The preponderant overall form of mistake was to build a design visually resembling some relevant generic device, but lacking functional connections or relations among its parts. In contrast to previous research on "naïve physics," which focuses on students' tendencies to think in pre-Newtonian ways, these results were frequently pre-Archimedean.

... More than half of those interviewed concurred in one or more of the builders' mistakes. Statistics of these scores, while limited, suggest inverse relationships of mechanical comprehension to both academic grade-point average and advancing class year."

In short, the students did not really understand simple machines, understood less as they progressed toward a degree,

and were even less likely to understand if they had higher grades. Oops!

I was fortunate to supervise Ph.D. research by Benjamin Linder.³ Dr. Linder sought to understand more about the difficulties that students have in estimating engineering quantities. Given the widespread use of powerful hardware and software "black boxes" to analyze engineering problems, it seems very important that users be able to estimate answers to detect gross errors. As Dr. Linder conducted his experiments to understand the estimation process, he discovered that students, including the ones I thought I had taught, lacked the fundamental knowledge needed to make estimates. Two examples of his findings follow. The first example illustrates the seriousness of students' inability to estimate.

Dr. Linder gathered data in the Department of Mechanical Engineering at MIT and at five other departments of mechanical engineering. All ranked in the top dozen in the United States. The experiments involved statistically significant numbers of seniors in each location. In one test, students were given five minutes to estimate the energy stored in a common 9-volt transistor battery. The results are summarized in Figure 1.

These results are stunning. Seniors in mechanical engineering from our best schools are clueless about quantities of energy. They had not been trained to recognize errors, even errors of a billion. Moreover, approximately 20 percent of their answers could not be included because they were expressed in units of power, not energy.

As Dr. Linder's research continued, he suspected that stu-

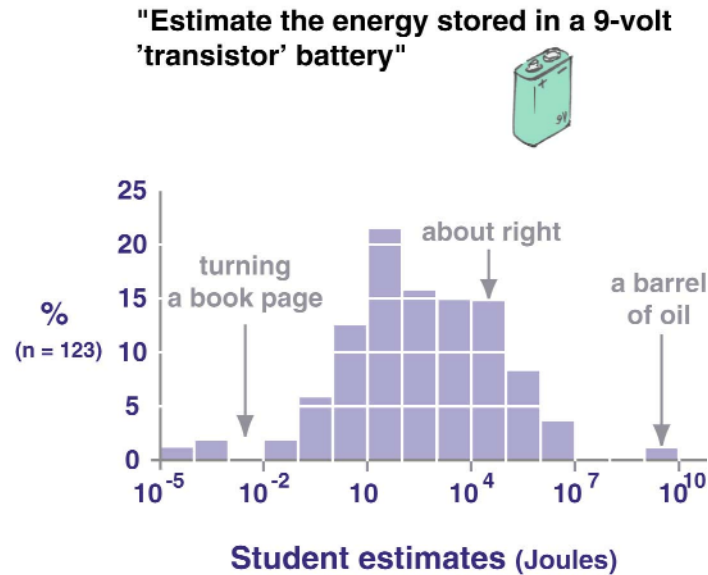


Figure 1. Summary of mechanical engineering seniors' ability to estimate the energy stored in a 9-volt transistor battery.⁴

dents could not navigate a back-of-the-envelope calculation because they did not know the units of the quantities they were trying to manipulate. Figure 2 summarizes results from a quiz in which mechanical engineering seniors at MIT in 1998 were asked the units of quantities common in mechanical engineering curricula. Each student was given a random set of 30 quantities. The quiz was administered to 120 students in a serious context. Any correct form of an answer was accepted.

One student gave an incorrect answer for the units of time. No student gave correct units for fracture toughness. Roughly 50 percent of the students got the units of Reynold's Number

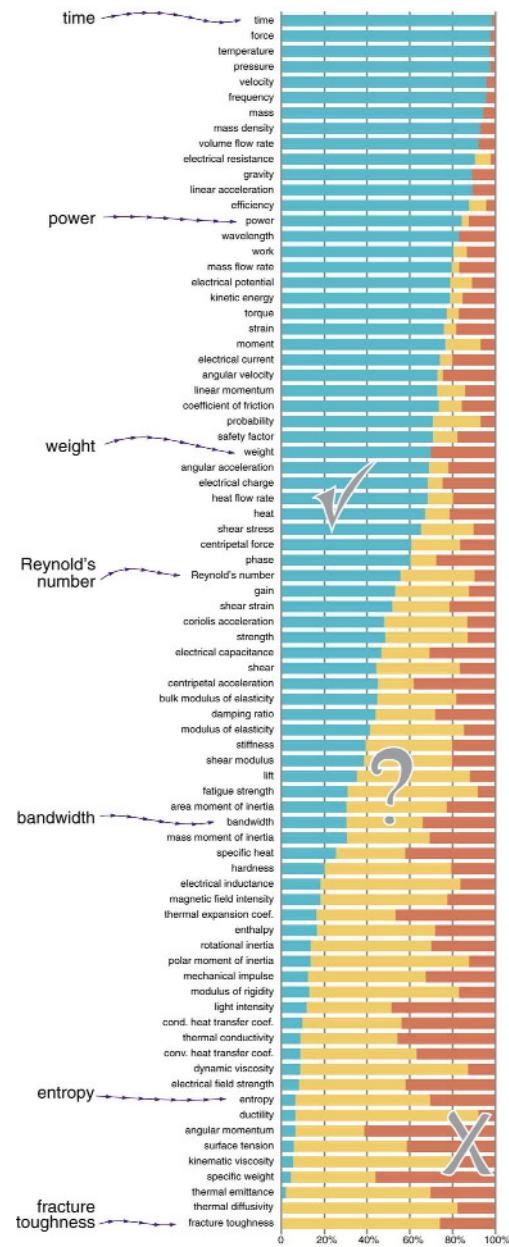


Figure 2. Results of units quiz in Dr. Linder's dissertation.
Selected labels are enlarged.⁵

correct. It is a number and has no units. Overall, the seniors knew the units of approximately half the quantities we had “taught” them. A follow-up survey asked our faculty which units the students should know. The faculty expectation was 90 percent.

Other studies have produced similar results. One of the most chilling is the infamous video of MIT mechanical engineering graduates, in cap and gown at graduation, being given a battery, a piece of wire, and a light bulb. When asked to light the bulb, they were unable to do so.⁶ Another sequence shows Harvard graduates explaining that our seasons are associated with changes in the distance between Earth and Sun.⁷

Can New Media Help?

Distance learning and new media learning are “cousins.” I have found that many colleagues dismiss distance learning as the trailer park in an otherwise respectable neighborhood. I regard distance learning as an essential part of an education system (see the sidebar on pages 106–107 for references to studies documenting that distance learning works).

Unfortunately, many studies of distance learning evaluate its efficacy for training rather than for education. However, since most residential programs also use tests that evaluate training, the studies show little difference. Evaluating education is a complex task, but I believe that if we could objectively evaluate education, well-designed residential programs would be demonstrably superior.

Distance Learning and New Media

Despite the fact that this chapter is not about distance learning per se, a very brief discussion of distance learning is presented, since many distance learning programs use new media. Many studies have been directed at the efficacy of distance learning as a mode of delivery of new media.

Dr. Diana Laurillard's book, *Rethinking University Teaching* (London and New York: Routledge, 1993), is an excellent reference on the effective use of technology in university education.

Technology Enhanced Learning, Paul Goodman, ed. (Mahwah, NJ: Lawrence Erlbaum Associates Publishers, 2001), is another recent and important addition in this rapidly changing body of knowledge.

Thomas L. Russell, Director Emeritus of the Office of Instructional Telecommunications at North Carolina State University, published *The No Significant Difference Phenomenon*, (AL: International Distance Learning Certification Center, 1999), presenting the summaries of 355 studies that report "no significant difference" between distance and classroom learning. Studies published since the book was printed can be found at <http://teleeducation.nb.ca/nosignificantdifference/>.

Russell plans to update his book with a section including at least 24 studies that do show a significant difference between distance and classroom learning. In almost all of these cases, the difference favored distance learning. More information is available at <http://teleeducation.nb.ca/significantdifference/>.

Another valuable recent publication is "Online Education: Learning Effectiveness, Faculty Satisfaction, and Cost Effectiveness," *Proceedings of the 2000 Summer Workshop on Asynchronous Learning Networks*, Vol. 2, John Bourne and Janet Moore, eds. (Needham, MA: Sloan Center for OnLine Education, 2001).

Examples of studies that evaluate the impact of new media appear in the research done by Professor David Wallace. Philip Mutooni, and Suzanne Weiner.^{8,9} In the first study, Professor Wallace and Mr. Mutooni developed a "Web lecture" that was compared to a traditional lecture covering the same material. The experiment was conducted in a graduate course in product design at MIT. The material covered was purposefully quite "soft" by engineering standards, including things that one would not expect to learn from a screen. The focus was on techniques needed to make a convincing visual model of a proposed new product. Sanding, painting, and sharpening tools were important. Professor Wallace invested 500 person hours in preparing material that students were expected to "cover" in one hour. He used slides, voice clips, captions, video clips, and text as required. Half the students used the Web-based presentation, and half attended a very well-prepared, demonstration-rich lecture.

As judged by a group of outside industrial designers, the Web lecture group built better models than the group on the traditional path. The Web lecture students used the Web lecture repeatedly as a reference as they applied the techniques they were taught. They did so even though they had to go to a computer and log on to review the materials. When “broadband to the hand” becomes common, this easy-reference advantage will be even more obvious.

In the second study, Wallace and Wiener presented a new group of students with the results of the first study and told them that all students would be expected to use the Web lecture. However, half the students were told that they should review the materials before a classroom discussion of the techniques, while the others were told that they should review the material before coming to a lab session in which they would be expected to use the techniques. In this experiment, the students expecting to demonstrate their skill through actual performance were extremely diligent in reviewing the material, whereas the other group was very lax in their preparation.

In the second experiment, the outside evaluators saw so much difference that the students were informed that their grades would be shifted to avoid an unfair disadvantage for the “classroom discussion” group.

The Web lecture material prepared by Professor Wallace was impressive. He is both a mechanical engineer and industrial designer. However, his materials were not comparable to a modern movie or video game.

One additional example warrants citation: Professor John

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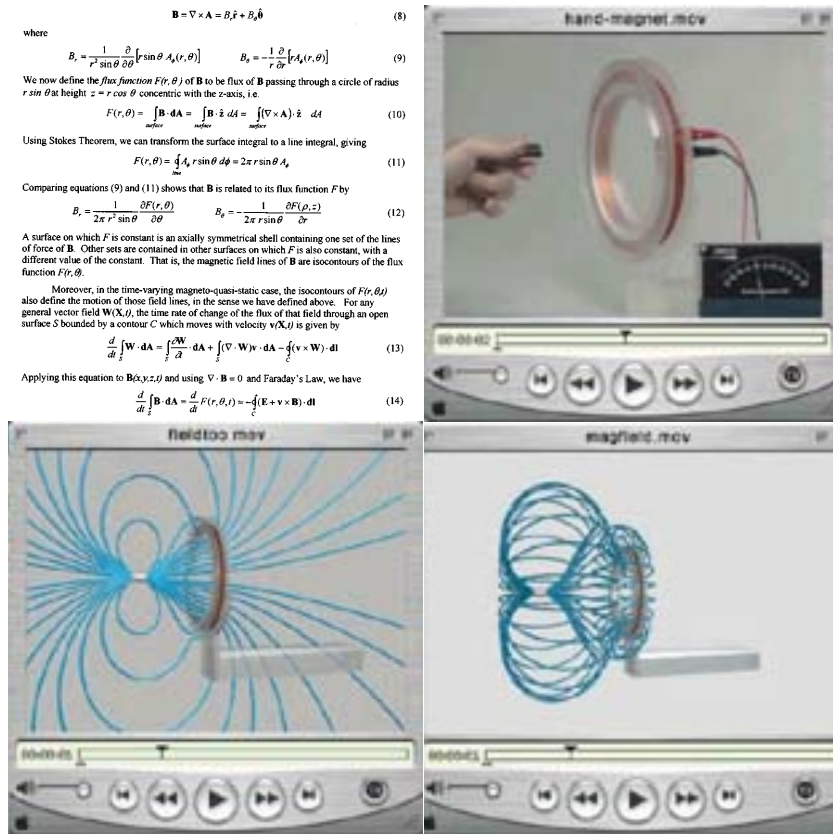


Figure 3. Professor Belcher's illustrations of the behavior of fields in diverse media, from mathematics, to experiments, to animated simulations.

Belcher of the MIT Department of Physics is an expert on field theory. He has produced animated illustrations of electromagnetic fields surrounding magnets and coils in several situations.¹⁰ Figure 3 shows four images that illustrate his work in

three formats: the symbolic mathematic description of the fields, an experiment that measures current in the coil as evidence of the fields, and the animations of the field lines in two views.¹¹

Even though I am somewhat familiar with mathematics and have deep appreciation for learning from experiments, I find that the animated computer-generated illustrations offer much greater insight about the behavior of the fields. That insight is profoundly greater in the regions around mathematical discontinuities. In this case, when an expert invests heavily in creating accurate and illustrative materials, we can learn about complex phenomena quickly and effectively.

Based on personal experience and studies that I know well, I have no doubt that well-illustrated materials can be extremely effective as learning aids. The best lecture I have ever given would be no competition for a professionally produced new media version covering the same material, especially if that material were always instantaneously available to the learner in the style she or he preferred.

New media technologies offer the academy the opportunity to create positive changes. We can use new media for training and use humans for education. This would result in residential programs being used only for things that require presence. Training does not justify the costs of most university experiences. Education does.

Distance learning can provide education, although it's harder to educate than to train over distance. Whether educa-

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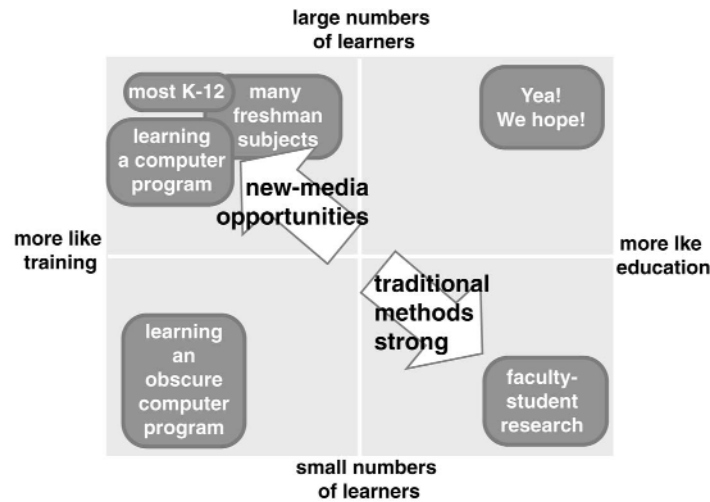


Figure 4. New media opportunities distinguished by market size and the degree to which the material to be learned is codified.

tion or training is provided, however, depends on how the system is designed. High-quality new media can serve both. Some of the more obvious opportunities for new media materials and telepresence are illustrated in Figures 4 and 5.

I further argue that a typical freshman year is almost the antithesis of a good maturation environment. New media training systems should enable much more appropriate experiences for helping young people become adults. I will present several scenarios to illustrate how things might be if we took better advantage of technology.

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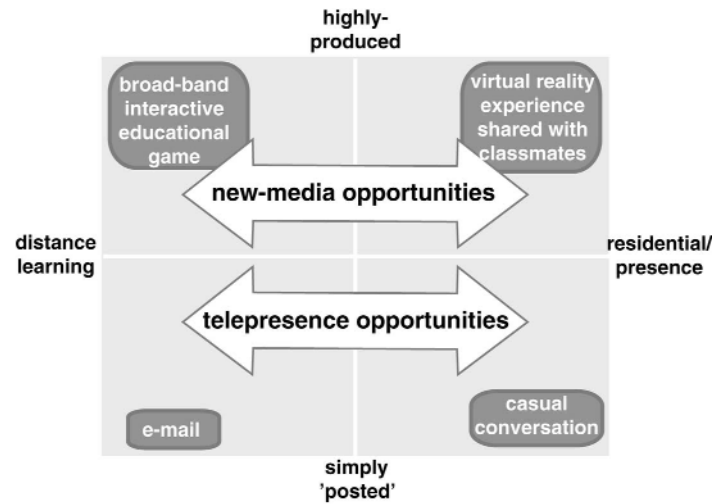


Figure 5. Broad opportunities exist for both new media and various forms of telepresence. They are likely differentiated by the intensity with which each is produced.

New Media As a Seed for Change?

Communication with others and with self is at the core of our large and complex education system. New media seems to offer an enhanced vehicle for both types of communication and therefore may allow improvements in a broad spectrum of learning activities.

Redesign of undergraduate programs

The following story contrasts three models of a freshman year. One is traditional, one assumes a work-study, pay-as-you-go model, and the other is a hybrid of on-campus and on-site learning. Three long-time friends meet during Christmas break of their first year in college. After enthusiastic greetings they sit down to talk about their lives during the last several months.

Elaine "This has really been an intense experience. Since I left you guys in August I haven't taken a break. I'm so happy I decided to attend Hybrid University."

Alan "I'm psyched too. Old U. is just right for me. Sue Ellen, how was it being a student and an employee at the same time?"

Sue Ellen "It's been hard, but I've learned a lot about myself and what I'll be doing in the future. Graduating with no debt will be great! Nice thing is, we're using the great new e-texts. Those systems really make it easy. I just log my time with the e-book, do the homework, and take the quizzes. My boss at work keeps complaining that she had to learn from a droning professor. Intern U. is just fine for me!"

Alan "I guess that's ok for you but I'm having a real blast. My new fraternity brothers are really crazy. My roommate stays drunk about half the time. I don't know how he passes any of his courses. Last Saturday, I literally had to carry him

home after the big game. I thought he was gonna puke his guts out. I guess I don't have to remind you that we won the conference championship. If we hadn't gotten nailed for that stupid grade-cheating thing, we would have been eligible for a bowl game!"

Elaine "Different strokes for different folks. I've spent the last four months in a small village in northern China. They don't have tailgate parties there, and the upset stomachs are not from beer but from the local water. I had a great experience. Five of us freshmen and two seniors delivered a water purification system to the village, set it up, and taught the local people how to maintain it. The little power system attached to the water pump gave us enough power to run our communications so that we could keep up with our freshman modules. Since the translation software was online, the local kids could share the learning experience with me. Look at these pictures! That's me in the middle. The girl just to my left taught me how to cook some great Chinese dishes. I'll show you guys."

Alan "You mean you'd rather do that than go to the college that has the best football team on the planet?"

Sue Ellen "Alan, did you learn anything? We did! Elaine and I even shared a study group. Since she had a satellite link we were able to work together on calculus. The e-text made that really easy. It was great for me, 'cause you remember how good she is."

Elaine "I can hardly wait 'til I get to the campus in January. Hybrid U. essentially guarantees that I'll spend all my time

on campus doing stuff rather than studying about stuff. All in small groups and all as real as can be. One of the modules I'll take is on economic development in rural China. That professor better know what she's talking about. Five of the 15 students in the group have spent time in different parts of China. Three even speak fluent Chinese. A graduate student in the seminar has been helping develop curriculum materials for the huge outreach program that Hybrid University has in China.

Alan, I'm amazed that almost half the universities in the United States still operate like Old U. You're doing the same thing that my parents did. You probably attend lectures and take notes! Why?"

Technology offers the possibility of designing knowledge distribution programs that cover the spectrum from "always there" to "never there." The "never there" range is at least feasible: Eli Noam pointed out that the core benefit proposition for the university has changed.¹² Knowledge does not reside at the university, so people need not come to the university to receive knowledge. In the scenario above, Hybrid U. has a freshman program designed to include a different type of maturation experience for the student. In one model, during part of the first year, each student would "serve" half time and receive knowledge half time. That's one of many models that could be far superior to the traditional university experience, in which most freshman courses focus on training and have little to do with education. New media modules could very effectively

obviate them. Learning calculus, for example, is training, while learning to think *using* calculus requires education.

Harvey Mudd College has shifted away from the traditional model. Professor Michael Moody, who was the Chairman of the Mathematics Department at Harvey Mudd College and is currently the Dean of Faculty and Professor of Mathematics at Olin College, explained while he was still at Harvey Mudd College,

“We do have a remnant course that is one-half semester long. In this course we focus on review of concepts and more difficult material. Much of the more technique-driven aspects of the course are in fact moved to a Web-based tutorial system, where students must pass competency quizzes by a certain date (different for each topic). . . ”¹³

If it's true that some of what we now do in residential programs could be accomplished through new media, what should happen on campus? Answering that question is one of the great challenges for academia. We must learn what parts of education need or require residence or presence and what parts do not. Clearly, students who have the luxury of being together and learning with other smart, motivated students gain enormously. In *Making the Most of College*, Professor Light points to the importance of learning from classmates.¹⁴

However, not all students are able to live in the midst of intelligent and culturally diverse colleagues. World-class new

media can help academia fulfill its obligation to those students who are not so fortunate. Distance learning programs can be much richer. For example, Sue Ellen has chosen Intern U. because it offers an opportunity she can afford. There are 10,000 other less fortunate students for every student who can attend an elite residential school.

"They'll Never Replace Lectures!"

One of the deeply entrenched romantic ideas blocking progress is the notion that lectures are sacred. Not long ago, in an exciting exchange about education, a colleague asserted flatly, "Well, they'll never replace lectures." I argue that "they" will.

Consider, for example, the following scenario on using voice-to-voice e-mail.

XX: Jane, what's happenin'?

YY: Too much. I'm running to the project lab. What you got?

XX: Try this neat thing! In Product Development 2, I'm teaching the others about the history of the technology we are using. I went into the archives and found a lecture from last century by this guy, Carl Sagan. That's the way they used to teach, you know. Anyway, I got bored and decided to put the stuff in different context. You remember Brittny Spears, really hot about 10 years back, and Joe Cocker, the weird 1960s rocker. I fed Sagan's words through a Brittny Spears

body model and a Joe Cocker style modulator. Put on your surroundphones and try it. You have never experienced “billions and billions” like that!

YY: I’m into it! Just tell your system to tell my system the locations. Call the set “old stuff.” I’ll ask for it in a study break tonight.

This scenario is almost possible now. Look at the pieces. Some of this chapter, for example, is being written with Via-Voice, IBM’s voice-to-text software. It’s quite accurate, keeps up at normal speaking speed, and was inexpensive (about \$80 including the headset). The late Professor Michael Dertouzos eloquently argued that we will stop using keyboards soon.¹⁵ More natural interfaces will prevail.

Ananova stands ready to read the news to us.¹⁶ She is not a state-of-the-art rendering, only a talking head, but one can easily look at a video clip from *Final Fantasy*, the wholly animated movie, and see what the next-generation Ananova will be like. Matrox Graphics just offered Matrox DualHead so that people can communicate through animated 3-D models of their own head speaking with their own voice.¹⁷

Michael Macedonia and Paul Rosenbloom described how the entertainment industry is driving rendering hardware and software quickly beyond the performance needed for the scenario above.¹⁸ Furthermore, costs will soon be low enough for mass use. Professor Steve Jacobsen developed a skinless, faceless robot that convincingly mimicked Joe Cocker’s style years ago. We are near the point where any stream of words, spoken

or typed, can be “played” through an image of a person, animal, or thing, in the voice and style one selects. We are near the point that such an animated image could respond to natural language questions and answer with great authority.

“The lecture” is *not* sacred. We must work harder to understand what it is about being in the same room with another person that helps learning. Whatever that is may be sacred. Computers can help us with much of the rest.

Expanded Alliances in Education

Imagine reading the following press release:

WORLD WIDE WEB RELEASE JANUARY 21, 2008

Six universities and twelve for-profit companies have ended a marathon negotiating session by signing an expanded alliance agreement. Starting next fall, most of the materials considered “commodity” learning materials will be updated so that modules developed by any alliance member can be mixed with those from other members. Dr. Barbara Runningbear praised the National Academy of Education for undertaking the task of creating the matrix of disciplines and applications that served as the map most alliance partners used in developing their content modules. “Although we do have overlapping materials, few resources have been wasted on wholly redundant modules,” she said.

At the end of the integration process, anyone who desires to support a learning system will be able to assemble a series

of modules that cover the target content, and then add the testing and simulation services of their choice. High school teacher representatives in the negotiating team were excited to announce, “No more homework and quiz grading!” while the university faculty seemed more excited about the prospect of outsourcing major parts of codified materials to cyberteachers. They hope now to concentrate on helping university students develop their creativity and critical thinking skills.

The Justice Department has given a preliminary nod to the alliance agreement. Although alliance members have a substantial competitive advantage, there will still be competition both within the alliance and with other learning systems.

The movie industry would not survive if each \$50 million-dollar production was an assembly of 50 one-million-dollar movies. The video game *Exile* would not be beaten in the marketplace by 2,000 *Pong* games. Likewise, the cottage industry model of education will not survive competition from world-class, well-organized, accurate, pedagogically solid, entertainment-quality educational materials.

Teaching small groups is fun. It's particularly enjoyable when no one is looking over your shoulder, when you can “wing it” if you choose. One can even design exams that make it appear that the group is learning the material well. Too bad that practice can become so easily corrupted and degraded to a less efficient state.

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Although I am quite confident that, at least for a while, part of education will continue to be pursued through interaction between a professor-like person and a small group, I do not think the small autonomous group model will survive for commodity training.

A New Textbook, 423rd Edition

New media educational material will allow continuous improvement of the education process and compound growth of quality. The following scenario illustrates what might happen.

The Learning Alliance

Committee for Continuous Improvement: Physics

Meeting Minutes, June 15, 2006

In attendance:

Professor Albert Wong, University Faculty

Representative

Dr. Jane Appleton, User Group Representative

Mr. Chester Davis, User Group Representative

Professor Ellen Sachs, Co-Author

Dr. Eddie Sankowitz, Computer Systems Specialist

Dr. Elvira Smith, Educational Psychologist

Mr. Mack Hidalgo, Animator

Meeting purpose: To discuss the results of the most recent round of exams.

Professor Wong opened the meeting by noting that almost 100,000 students, or 20 percent of those taking the examinations, made subtle mistakes on questions relating to free-body diagrams. Students' scores improved overall, but not in every module. He suggested that the meeting focus on improving the module on Newton's Laws.

Both Dr. Appleton and Mr. Davis reported that their students asked questions about free-body diagrams for rotating objects. Dr. Smith suggested that the existing animations left students confused about the true meaning of "equal and opposite." He explained that the real-time superposition is wonderful if you know what to look for, but for newcomers the illustration moves too quickly to help understanding. Mr. Hidalgo expressed excitement about understanding the conceptual error. He had several suggestions for eliminating the confusion.

A consensus vote indicated that improving this section of the module should have highest priority, and everyone expressed confidence that the confusion would be eliminated before the next round of heavy usage.

Thirteen other relatively minor improvements were suggested. Dr. Sankowitz said that most of them would be automatically fixed with the next version of the edu-browser software, since several of the problems resided in the voice-to-command interpreter due for update this week. Professor Sachs added, "Our product continuously improves and everyone knows it!"

Professor Wong closed the meeting with an announcement that 15 new universities had adopted the Learning Alliance Physics e-text. This new tuition revenue will complete the repayment of the \$20 million investment to create the original set of modules. Now that cash flow will become positive, Professor Wong will ask the board of directors to appoint a committee to decide how to add discount and free subscribers, given that the marginal cost of adding users is so low. A straw vote endorsed a rapid expansion of free subscribers in developing countries.

Continuous improvement based on feedback of effectiveness will have a positive impact on learning material and on the service that supports them. E-texts will evolve rapidly. Massive amounts of data will show how different users learn and which illustration techniques are the most effective.

David Prichard, Professor of Physics at MIT, has developed an archetype of this improvement process, called *CyberTutor* to help students learn physics. In its original form, it was an on-line homework system. Students were encouraged to keep working on problems until they got them correct. The data representing the number of "hits" per student provided a clear guide to where improvements should be made. For Professor Prichard and his teaching assistants, the first order of business at the end of each semester was to examine and improve the troublesome problems.

One can readily imagine a dozen correlations or algorithms

that could lead e-text designers to problematic parts of a system, allowing faster and more targeted improvements. Even Professor Paul Samuelson's extremely successful texts on economics have had only 17 revisions over the 50 years of their popularity (more than 4 million copies sold). E-texts could have a new edition every week, and automatic translation systems could update the e-text in every language.

Not only can pedagogy evolve, but content could be updated without spending hundreds of millions of dollars on texts. In high school and in college, I was taught science that was known to be wrong for decades, but was still in the textbooks we used. James Loewen argued eloquently in *Lies My Teacher Told Me* that most of our high school history textbooks are simply wrong.¹⁹ Imagine that those texts are electronically accessible. Although wholesale change in their content would generate tremendous controversy, the books could evolve as consensus among scholars develops. I would guess that few university history professors today think they have a chance of changing what high school students are being taught. Nor are they likely to see their careers advancing because they choose to "tilt at windmills." If new media texts were widely used, effecting positive change could be a much more meaningful measure of scholarship than an article in an obscure journal.

Change in Small Markets

Thus far, I have been speculating about innovations that might occur in commodity training: the high-enrollment topics in

high school and undergraduate college. A Ph.D. research seminar, on the other hand, might change in very different ways, as described in the next scenario.

AllTech University, March 2004

As Josè walks toward the conference room, he is frustrated. He didn't shave very carefully this morning and knows that the high-resolution broadband conferencing video will allow his colleagues at the other three universities to see him clearly. At least he has done his homework and is ready for the discussion.

As he enters the classroom he hears a heated argument about which place has the best weather. The students in California have turned on the outside camera. They're showing bright sunshine while he dusts the snow off his shoulders.

In a few minutes all four locations are online, and the professors have suggested that the discussion get under way. Professor Genrich from the University of the South is excited about results from an experiment completed last night. Professors Genrich and Able agree to start a publication together on the PublishSite. Professor Able has time to draft the monograph since his teaching load has been reduced through this conference-course arrangement.

José knows that he is probably one of the first few dozen people to hear about the new results. He feels very

lucky to be participating in this course, which involves four of the world's most famous professors and two dozen of the best students in his field. Just a few years ago, before everyone realized that every school did not have to have an in-depth course on every doctoral-level topic, he would have been stuck with a much smaller selection of specialty topics and probably would not know his new colleagues. The network has been great for professional networking.

Today in his presentation, he'll try hard to impress Professor Leland. Although he has never met her in person, he feels he knows her work well and hopes he can soon join her as a colleague.

Commodity topics will justify the large investments needed to create rich, engaging, and carefully crafted materials. The good news is that even learners who are not thirsty for some of the commodity knowledge will be treated to elegant presentations—a win-win situation. However, students conducting research in a narrow area will likely be content to use much cruder systems as long as they learn from the most knowledgeable scholars in their field. Graduate programs could be enhanced through cooperative arrangements among groups with similar interest. In my field of design engineering, for example, I can imagine a super series of about four courses, each taught by an outstanding faculty member from one of the premier institutions. The course responsibility could rotate so that each faculty member's teaching load would be equally re-

duced. The small community thus created would enable more rational recruiting and could even spawn new research consortia. In this case, the “new media” is simply enhanced teleconferencing.

More Appropriate Alumni Relations

Another scenario demonstrates how relationships between institutions and their alumni might be improved in very productive and innovative ways.

A conversation around the water cooler:

Don: “We simply must hire a consultant! The boss will flip out when we bring it up.”

Pabon: “Don’t look at me! That correlation technique was still a research topic when I was a student. I just don’t know how it works. It does sound like it would solve our problem though.”

Erin: “Slow down guys. I checked out my school’s e-texts system. Since my profile is on file there, all I had to do was ask what modules I must cover to get to the point where I can do the correlations myself. Over 10 days, if I spend four hours a day and go at the average pace, I can do it! All I need is some time. As an alumnus, access to the modules is free for me. I don’t want to rub it in, but you guys should have gone to a better school. All your alma maters do is beg you for money.”

Don: “Yeah, but I’ll bet you give more to U of X than I give to Old U!”

Erin: “You got that right! U of X was not stupid. They’ve helped me in my professional growth a dozen times since I left. My kids are using some of their introductory modules and excelling in their classes. My partner and I are sitting in on a great philosophy discussion. I’ll keep supporting them, and you can bet U of X is in my will big time.”

More rational alumni relations are clearly overdue. MIT has its own form of alumni dysfunction. For the last two years, the graduating class has chosen to put the acronym “IHTEP” on its class ring. The romantic version stands for “I have truly found paradise.” The much more common interpretation is “I hate this f— place.”

For hundreds of schools, homecoming is about football, and alumni relations center more on the coach than the college president. Until the academy has the courage to push for a more relevant connection with alumni, varied forms of surrogate relationships will prevail. Until we can offer our graduates something akin to what Professor Richard Larson calls an Educational Maintenance Organization, graduates will choose some other focus for their time and energy than keeping up a relationship with their alma mater.²⁰

Maintaining active ties with graduates by offering opportunities for continued growth and education is a vast improvement over intellectually abandoning our students on gradua-

tion day. New media can facilitate this profound change and can help nurture graduates' pride based on their ongoing intellectual interaction with their alma maters.

Conclusion

Imagine an article in *USA SOMEDAY*, October 21, 2010:

Somewhere, USA: Today Dr. Barbara Runningbear departed for Stockholm to receive the first Nobel Prize for Education. In an emotional send-off party, her faculty colleagues hailed her as a strong leader who courageously supported the University Learning Alliance's (ULA) early entry into 21st century education. The ULA was described as the most powerful educational force on the planet, with over a billion e-text customers. Some students attending residential universities, especially in developing countries, claim to be influenced more by ULA than by the faculty at the university they attend. The celebration flowed into the streets as Dr. Runningbear boarded a limousine.

A Nobel Prize in Education? Why not? All other Nobel Prizes are the children of education.

Many large industries have changed dramatically in the past few decades. The automobile industry has been positively transformed. This industry has learned tough lessons and still faces tenacious competition. Medicine, too, is profoundly

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changed. A friend who is a physician told me recently that he did not know one fellow physician who did not dream of “getting out.” Sometimes big shifts occur despite fierce opposition from those being shifted.

Perhaps for the first time in our country’s history, academia will change quickly as well. If we take full advantage of the opportunities before us today, we could emerge proud of academia’s new status. Higher education might be afforded greater respect and viewed as a source of hope in building a global society strengthened and supported by an ever-expanding body of knowledge and reason.

ENDNOTES

1. J. Daniel, “Why Universities Need Technology Strategies” (adaptation of an address given in March 1997), *Change*, July/August, 1997, pp. 10–17.

2. C. Miller, *So Can You Build One? Learning through Designing: Connecting Theory with Hardware in Engineering Education*, Ph.D. Dissertation, Department of Mechanical Engineering, MIT, Cambridge, Mass., 1995.

3. B. Linder, *Understanding Estimation and its Relation to Engineering Education*, Ph.D. Dissertation, Department of Mechanical Engineering, MIT, Cambridge, Mass., 1999.

4. Ibid.

5. Ibid.

6. *Can We Believe Our Eyes, Minds of Our Own Video Series*, producer and director M. Schneps, Annenberg/Corporation for Public

Broadcasting, 1997, videocassette, MIT Graduation. Also available at <http://www.learner.org>.

7. *A Private Universe*, executive producer M. Schneps and director and producer P. Sadler, Annenberg/Corporation for Public Broadcasting, 1988, videocassette, Harvard Graduation. Also available at <http://www.learner.org>.

8. D. Wallace, and P. Mutooni, "A Comparative Evaluation of Classroom and Web-based Teaching," *ASEE Journal of Engineering Education*, 1997, Vol. 86, No. 3, pp. 211–217.

9. D. Wallace and S. Weiner, "How might classroom time be used given WWW-based lectures? A comparison of lecture-style second coverage of materials vs. limited-guided experiential activity," *ASEE Journal of Engineering Education*, Vol. 87, No. 3, 1998, pp. 237–248.

10. See <http://web.mit.edu/jbelcher/www/anim.html>.

11. J. Belcher and O. Stanislaw, "Field Line Motion in Classical Electromagnetism: The Expanded Version," in press, 2002. The paper can also be found at <http://web.mit.edu/8.02t/www/FieldLineMotionPapers/FieldLineMotionExpanded.pdf>.

12. E. Noam, "Electronics and the Dim Future of the University," *Science Magazine*, Vol. 270, No. 5234, Oct. 13, 1995, pp. 247–249.

13. Personal communication to the author through e-mail.

14. R. J. Light, *Making the Most of College* (Cambridge: Harvard University Press, 2001).

15. M. L. Dertouzos, *The Unfinished Revolution: Human-Centered Computers and What They Can Do for Us* (New York, Harper Collins Publishers, January 1, 2001).

16. See <http://www.ananova.com>.

17. See www.matrox.com/mga/.

18. M. R. Macedonia and P. S. Rosenbloom, "Entertainment

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Technology and Virtual Environments for Training and Education,” *The Internet and the University: 2000 Forum* (Boulder, CO: EDUCAUSE, 2001), pp. 79–95.

19. J. W. Loewen, *Lies My Teacher Told Me* (New York: Touchstone, 1995).

20. R. C. Larson, “MIT Learning Networks: An Example of Technology-Enabled Education,” in *Forum Futures: 1998 Papers*, M. Devlin and J. Meyerson, eds. (New Haven, CT: Forum Publishing, 1999, pp. 59–74.

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