Educational Technology Points of Inflection

Michael D. Bush

Educational Video on the S-Curve of Video Technology Development

Introduction

The viewing of still images in rapid succession has been referred to as moving pictures, movies, motion pictures, television, film, or video. No matter the name applied over the years, the future of visual display technology has been difficult to predict. This difficulty would not be a surprise to forecaster Paul Saffo, who in the cover story of the 2007 July/August issue of the *Harvard Business Review* provided several key insights on the problem of predicting the future of technology. Citing futurist Roy Amara, Saffo made two key points. First is the tendency to overestimate the near term and underestimate the long term potential of new technologies. Second, "most ideas take 20 years to become an overnight success" (p. 127). He summarizes the situation with the statement, "innovators and would-be forecasters who glimpse the flat-line beginnings of the S-Curve often miscalculate the speed at which the inflection point will arrive" (Saffo, 2007, p. 127).

The development of video in education is a case in point more extreme than the various examples cited by Saffo in his *HBR* piece (television, the Internet, and innovations of Silicon Valley in general). In 1913 Thomas Edison predicted that "Books will soon be obsolete in the schools. Scholars will soon be instructed through the eye. It is possible to teach every branch of human knowledge with the motion picture.

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6 THE MOVING PICTURE NEWS

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Figure 1. Advertisement for Edison's Kinetoscope from the *Moving Picture News*, January 18, 1913.

Our school system will be completely changed in ten years" (Saettler, 2004, p. 98). (See ***Figure 1*** for an example of the technology Edison was promoting.)

While educational video has been a reality for many years, Edison's failed prediction regarding textbooks (failed thus far at least!) supports Amara's and Saffo's observation of the tendency to overestimate the near term. Yet, it should be obvious that the overall technological impact of video has been underestimated and is being felt in areas other than education in ways that Edison would never have predicted. This not only grandly confirms the tendency to underestimate the future but it also suggests that the future for video in education could eventually achieve a scale much more extensive than even Edison imagined, simply based on the number of lives that can be touched via digital distribution. As preparation for the discussion of video in education, let's examine the changes in video production and distribution that promise to make this possible.

Video in Context: Some Historical Perspective

The first view I had of the potential for the mass availability of video for education came in 1986. Interested in interactive video for education and totally ignorant of Edison's prediction, on the one hand, I was becoming

increasingly aware of a man named Bill Gates, on the other. I had first heard of him through work we were doing at the Air Force Academy with Texas Instruments (TI) on interactive video. Our TI contact spoke of work on Multiplan, a spreadsheet they were doing with the help of Microsoft, a company name that was gradually entering the consciousness of anyone involved with microcomputers in the early 1980s.

By the time that 1986 rolled around, I was fully aware of what Bill Gates and his company were up to. I was working for NATO in Paris, France, and made my way across the Atlantic and across the US to what the microcomputer press was increasingly making clear was going to be a major happening. Over a thousand people paid over a thousand dollars each to attend Microsoft's First International Conference on CD-ROM in Seattle (Rosen, 1989). Microsoft was preparing its initial public offering that took place later that year, which meant that Bill Gates was not yet the richest (today, the second richest) man in the world. The result was that he was very approachable, and a group of us hung around the lobby of the conference center into the evening, eating huge shrimp and carrying on a group conversation with Bill himself. ("Bill is holding court," as a colleague described it.) Just as I had, everyone had made their way from points all over the globe to Seattle to attend what some called the "Woodstock of CD-ROM."

In any event, a small group of less than a dozen of us chatted with Gates, with some in the group peppering him with questions about CD-ROM and its potential (or lack thereof) for delivering high-quality video. I listened to several guys, no doubt enamored with videodisc technology, the interactive video technology of the day, hammering Gates with questions about bandwidth and its implications for video:

> "But you don't have the bandwidth! You don't have the bandwidth!" they said. Gates' response (to paraphrase) was, "Don't worry about it. Processors will get sufficiently fast, and memory will get tolerably cheap to give us the power we need. Once your material is digital, you can do so much more with it." (Bush, 1996)

Although Gates was not referring at that point to online video delivery, the implications of his pronouncement were that this would happen. Furthermore, the transformation was not too long in coming. In fact, that reality came very close to happening within the 20 years predicted by Amara and Saffo. A key interim step involved the first shipment in 1997 of DVDs via the US Postal Service from Netflix, which lived up to the promise of its name in 2007 when it began streaming movies via a Web browser with a plugin (Netflix, 2014). This development came almost exactly 20 years after Gates' statement about the capabilities of digital video. Later, with its streaming video business booming, Netflix reached a new milestone on January 16, when a Netflix-backed production, *The Square*, was nominated for an Academy Award (Solsman, 2014). In addition, on January 24 the company released online *Mitt*, a documentary about Mitt Romney, the Republican Party's nominee for President of the United States in 2012. Such developments have profound implications for Hollywood, which to date has been the world capital of video-based content.

This would not be a surprise for anyone who read George Gilder's book, *Life After Television*, which he first published in 1990, just four years after Gates' declaration. If anything, what we are seeing today is even more impactful than even Gilder had anticipated. He predicted that the television industry, established from the outset on the premise of big companies producing content for a few networks, would eventually cease to exist. The reason, he explained, was that TV is a broadcast medium, the survival of which is dependent on its attractiveness to the masses. In other words, it must create content with the defining characteristic being what the largest number of human beings have in common. Here are Gilder's words:

> TV defies the most obvious fact about its customers—their prodigal and efflorescent diversity. People perform scores of thousands of different jobs; pursue multifarious hobbies; read hundreds of thousands of different publications. TV ignores the reality that people are not inherently couch potatoes; given a chance, they talk back and interact. People have little in common except their prurient interests and morbid fears and anxieties. Necessarily aiming its fare at this lowest-common-denominator target, television gets worse and worse every year. (Gilder, 1994)

The next chapter of the present historical perspective involves Paramount Pictures announcing that their Academy Award nominated film, "The Wolf of Wall Street," was being released ***only*** in digital form rather than on film. This makes them the first studio to take this drastic step of eliminating physical shipment of reels of film (Verrier, 2014a).

Reading about this announcement brought back images in my mind of the heavy canisters of 35mm film shipped to the movie theaters that my parents managed when I was a kid (see ***Figure 2***.). The cans came and went on the bus, bringing the excitement of Hollywood to the small towns where we lived. Crucial is the fact that Paramount's announcement almost guarantees that other studios will quickly follow suit, driven by some very simple calculations: The cost of a single print on film of a movie can cost as much $2,000 (Verrier, 2014b), not to mention the expense for shipping. The cost of the same movie as a Digital Cinema Package (DCP) (Digital Cinema Package, 2014) on a specialized hard disk will currently run less than $100 plus commensurate shipping costs. Eventually, even that cost will go away completely, as other means of distribution, such as satellite, become available (Verrier, 2014b).

The financial implications for the release of a feature film to 3,000 theaters are more than obvious for the studio, but the digital release also carries significant consequences for small-town movie houses such as the ones managed by my folks. If these theaters are to continue to exist, they must find a way to finance the digital projectors that are becoming necessary. Although these units are anything but cheap, even some budget theaters like the one we recently attended have already made the transition.

Netflix's releasing major new content online and Paramount's abandonment of shipping expensive film in heavy metal containers confirms a key principle laid out by Nicholas Negroponte in his book, *Being Digital* (1995). There

Figure 2. A photo of the type of heavy metal cans used for 100 yeas for shipping the reels of films for feature movies.

he describes a compelling vision of the benefits of dealing with information that is digital in nature rather than in some physical form. He discusses the problem as one in which bits rather than atoms should be "shipped" whenever possible, which is obviously a cheaper alternative for distribution, given that nothing needs to be physically transported, stored in warehouses, or displayed on shelves in stores.

Finally, we gain a bit more insight into the status of video in today's world by considering developments at the Sundance Film festival. This event takes place each year in Utah, and this year's event is underway as I write. For this cycle, filmmakers submitted a record 12,218 films, 72 more than last year. As explained by Gilder, now over 20 years ago, such numbers would never have been possible without the digital tools that every year become less expensive and more powerful. This improved price and performance ratio was a key justification for Gilder's predictions for television. Indeed, the subheading on his book was "The Coming Transformation of Media and American Life," which he attributed directly to the coming of the microchip to the industry that creates the content. Nowhere is that more evident than in the sheer volume of content being created by so many different people in so many different areas of the world.

The transformation hinted at by Gates is now just about complete. Movies have taken 100 years to transition to a totally new delivery mechanism, and that development path is fascinating in its own right. From highly flammable celluloid, to cellulose acetate film ("safety film"), to reel-to-reel tape, to videocassettes, and finally to DVDs, digital video distribution is now a reality. Whether applied to movies in the theaters or those to be shown directly in the home, video technology is now available on a scale that would absolutely astound Edison, were he here to see.

Moving Pictures of the Past to the Educational Video of the Future

I mentioned video in the previous installment of this column mainly to highlight the role it can play in "flipping" the classroom, a potentially key element in increasing the individualization of learning. The purpose in this piece is to draw from the lessons gleaned from the broader, video-based arena. This will allow us to shape the future and adapt to what is no doubt going to happen with educational video.

The first issue involves the scope of education. It would be pointless to argue with the implications of the complexity of today's world and the fact that there is a lot more to learn now than 100 years ago. Given that information and knowledge are increasing to the extent they are, it is not clear how education is going to be able to keep up. It makes no sense to believe that increasing content in the curriculum is sufficient when information is increasing exponentially. Nor is it logical or practical to think we can keep up by simply spending more money. Something has to be done differently, but what?

Part of the key is to recognize the importance of identifying a few fundamentals for every subject domain and then teaching the skills to deal with finding the additional information necessary to solve problems. Such an approach implies a careful balance between knowing and doing, suggesting that the professor or teacher in the classroom needs to change what happens in that setting. As described in the previous column:

> A teacher or professor in a classroom is a very low bandwidth channel of communication. We need to save the time of the teachers to do what they can do and technology cannot do. For example, teachers in the classroom can stimulate and motivate learners on an individual basis, and diagnose their problems. They can also contextualize and personalize instruction in order to broaden the range of learners for whom interaction with the teacher will be meaningful. (Bush, 2013, p. 62)

With respect to educational content, this approach involves the adoption of a granularity of content not unlike what we are seeing implemented by Khan Academy (Bush, 2013). In addition, online learning reflects many aspects of what Gates and Gilder both suggested was going to happen on the broader scale of digital technology and video. We should all find intriguing the fact that Bill Gates is the major financial backer and a very visible cheerleader of Salman Khan. In fact, not only has the Bill and Melinda Gates Foundation donated millions of dollars to the Khan Academy (Bill and Melinda Gates Foundation, 2011), but also Gates uses the videos with his own children (Kaplan, 2010).

Nevertheless, the initial developments for educational video somewhat parallel Edison's predictions with respect to the distribution aspect of the problem. As is the case for all new technologies, video was expensive for Edison and the producers that followed him, requiring that individual needs be essentially disregarded. This led to what became ***broad-***casting with all of the problems that Gilder delineated in *Life After Television* (1994), which means addressing the interests of the masses rather than the needs of the individual.

A significant quantity of educational video has been distributed over the years by "educational television" channels that have been affiliated with universities as Public Broadcasting System (PBS) stations. Unfortunately, the use of educational video was adamantly opposed from the earliest days in the

United States by teachers' unions (Levin & Hines, 2003). Despite those objections, however, available educational content has increased substantially in the cable television era with sources like Animal Planet, the Discovery Channel, the Biography Channel, Military Channel, History, etc. Interestingly, 13 of the wide range of channels in this category (71% of the total number of channels) are produced by only three organizations: 21st Century Fox, National Geographic Society, and Discovery Communications (List of United States cable and satellite television networks, 2014).

Not surprisingly, video from these sources mirrors what has been the norm in the regular broadcasting arena: TV program-sized chunks of video that occupy a typical broadcasting schedule, albeit with frequent re-broadcasting of popular programs. What they exemplify, however, is a story-oriented presentation that is designed to engage the widest possible audience of viewers interested in the topics targeted by each channel. The purpose, of course, is to make viewers want to watch the programs.

In contrast, a large number of the videos we see from Khan Academy take an important deviation from that approach by providing smaller chunks of content of about 12 minutes on average to view. Most of the videos are also what most educators would describe as didactic, and some are no doubt what many students would call boring (HiPointDem, 2013). The good news is that Khan has enlisted the help of people like Vi Hart, who had already made a name for herself in producing mathematical videos for YouTube (Math Jokes 4 Mathy Folks, 2013). From all indications, change is afoot at Khan Academy.

Conclusion

The history of broadcast video has not yet led to the future predicted by Edison for education, but evidence abounds that suggests change is underway. Furthermore, I would argue that the future is in fact nothing short of brilliant. The mechanism for virtually unlimited distribution is available, and the means for affordable production is a reality, as submissions to the Sundance Film Festival suggest. As a foreshadowing of the future, Gilder wonders:

> From the personal computer to the fiber-optic cable, from the communications satellite to the compact disc, our generation commands the most powerful information tools in history. Yet the culture we have created with these machines is dreary at best. Why doesn't our superb information technology better inform and uplift us? (p. 56)

Negroponte is remembered for having written in *Being Digital* (1995), "nothing, never, nowhere unless it is timely, important, amusing, relevant, or capable of reaching my imagination" (p. 174). To better predict the future for educational video, I prefer an amalgam of thought from Gilder and from Negroponte, which will guide us to the creation of video that gets at the purpose of education, which is about learning for each and every student. By recognizing that learning is about knowing and doing and that some learners take longer than others in that process, we can imagine videos that will help students learn outside the classroom in ways that will help teachers be more productive in the classroom and better able to address the needs of individual students.

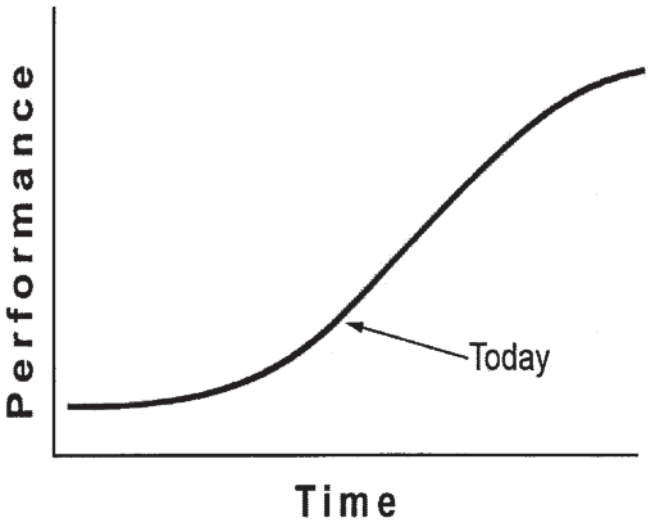

Figure 3. One take on the S-Curve as it applies to educational video.

So, at this point in time, where does education fall on the S-Curve of educational video development? The incredible advances of recent years suggest that we are at or near the first point of inflection. Even if we have already passed that point on the curve (see ***Figure 3***), just as studios are now abandoning heavy metal cans for shipping movies, it is quite possible that education publishers are about to relegate to the past the limitations of textbooks as the primary medium of distribution of their instructional content. This would open up opportunities for video distribution for education far beyond what is possible today, a future that is greatly enhanced by the potential offered by tablet computers.

Using what we have explained here about the status of video development in general, a safe, worst-case assumption for educational video would place today's status perhaps at the end of the exponential increase that has been experienced in the past. Even with that, the significant positive slope of the linear portion of the development curve suggests that significant, even amazing, advances likely lie ahead for video as an effective educational technology.

In our next installment we will explore why that is the case. Among other considerations we will look at how the wisdom of the ancients can help us produce the media of the future. This will involve an exploration of the style of video popularized by Vi Hart and what we believe it brings to Khan Academy, and whether it portends what is to come for video in education in general. □

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Q & A with Ed Tech Leaders

Interview with David M. Monetti

Susan M. Fulgham
Michael F. Shaughnessy
Contributing Editors

1. You are involved in both gifted education and technology. How do you combine the two?

I became interested in these two seemingly disparate areas because I saw them both as pressing needs in education. Based on the results of most of the large-scale reports on college readiness that I have read (ACT, 2013), we have a good bit of work to do. For big answers and innovations in the future, I think we are going to have to do a better job of encouraging gifted students. Having talent is wonderful, but that talent must be nurtured and mentored. Similarly, I saw technology as an important way to help students address the big questions and challenges in the future.

Technology is changing the ways all of us interact with the world. Those who are involved and understand technology will have expanded opportunity and access in the future. Isn't technology instruction a little like foreign language acquisition, where the sooner we can get students involved, the better outcomes we get?

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