Restructuring Education Through Technology: 30 Years Later

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Abstract

In *Restructuring Education Through Technology*, I incorporated systems thinking to identify seven types of relationships in educational systems: teacher-student, student-content, student-context, teacher-content, teacher-context, content-context, and education system-environment relationships. I listed typical examples of each relation in terms of what existed in 1990 and made predictions about what could happen to future education systems relations when computer and information technologies are introduced. Now, 30 years later, many of these predictions have been realized in K-12 and higher education systems. I now revisit these education system relations and discuss potential futures of education. The World Wide Web did not exist when I wrote the original treatise, nor did wireless smartphones and tablets, Google's search engine, YouTube, Facebook, or Wikipedia. However, one important education system relationship should not change: the emotional bonding between teachers and their students. I will explain why.

Introduction

You may not like my message—at first. But I have to speak up.

I am not a Luddite. Rather, a musician turned into a computer geek who later learned to become a philosopher and an educologist.

For several decades as a professor in Instructional Systems Technology, I have been leading the use of computer and information technologies to help support student learning. For example, our online tutorials and tests on *How to Recognize Plagiarism* have been used by millions of students worldwide since 2002. I have formally taught numerous college students, university faculty, and P-12 teachers to use computers in education, from the early 1980s through late 2012. These four decades span from the introduction of personal computers to our desktops, to a current World Wide Web culture: Google searches, YouTube, Amazon, iTunes, Facebook, Netflix, Twitter, Wikipedia, eBay, Uber, Western Governors University, flipped classrooms, and massive open online courses (MOOCs). And now there are Pixar movies animated in 3D, video games, and virtual and augmented realities. Fantasy and fiction can be easily conflated with facts—when all are encoded into digital bits.

Digital devices have shrunk in size but have become far more powerful—computers so small that they fit in our pockets, on our wrists, and inside many of the larger devices we use such as televisions, cars, smartphones, microwave ovens, and video game consoles. Flying drones with small cameras can now provide bird's eye views that we never had before. Robots in factories now build more and more of these devices, including more robots. Nearly everywhere we go, we can stay connected digitally through the trillions of bits of information that flow through optical fiber, coaxial cable, Ethernet, wi-fi, Bluetooth, and cellular networks. And GPS helps us get there.

As we enter the 2020 decade, 30 years have passed since I wrote a small book in 1990 called *Restructuring Education Through Technology*. It was published the following year, about the same time as the World Wide Web first became available to the public, in August, 1991 (https://en.wikipedia.org/wiki/World_Wide_Web). I could predict some of what was coming, because I knew what was possible. I also understood the limitations of digital technologies; and I still do.

We can use digital computers and information technologies to empower teaching and learning. These technologies allow us to educate in ways that we could not do without them. For example, printed books became educational resources following the invention of the printing press six centuries ago. Textbooks in 20th century classrooms were commonplace. Now computers and information technologies have become further resources for students and teachers to use. In addition to print on paper, they are using iPads, Chromebooks, smartphones, LED TVs, and video projectors.

However, *affective* teacher-student relationships and student-student relationships remain essential for good education. The social bonding that occurs between humans is vital, and computers are no substitute. Also vital is the bonding that occurs between students and their contexts, which are part of their immediate culture and experience. Media that include computers, televisions, and books are no substitute for that bonding either. I will say much more about these relationships below.

Media, Signs, and Making Meaning

In early days of computing, there was a common saying, "Garbage in, garbage out." There is actually considerable wisdom inherit in that pithy phrase. I want to clarify some basic

concepts, because I believe many people fail to understand what computers fundamentally are, and especially what they can and can't do:

> *For thousands of years humankind has built and improved routes and vehicles for transporting goods and people. We have built ships, highways, automobiles, trucks, railways, trains, airplanes and even dirigibles to transport things and people from one place to another. As we enter the twenty-first century, the most important new kinds of "highways" emerging are globally interconnected digital communications networks (e.g., the Internet).*
>
> *What is transported through these networks are bits of information. These bit collections can represent whatever we want them to, whether they stand for linguistic symbols such as letters of an alphabet, icons or ideographs, for moving pictures and sound, for computer programs, stock market prices, or bank account balances.* (Frick, 1997, p. 108)

Long before computers were invented, Charles Sanders Peirce (1932) referred to *signs* when he discussed the foundations of semiotics: "A *sign*, or *representamen*, is something which stands to somebody for something in some respect or capacity" (2:228)…. The Sign can only represent the Object and tell about it. It cannot furnish acquaintance with or recognition of that Object" (2:231).

Fundamentally, what computers do is manipulate and transmit *signs*. When discussing problems of artificial intelligence and natural language understanding, I noted that computers "… blindly reason and follow procedures that manipulate symbol systems, images, sounds, icons and the like with no cognition of their meaning" (Frick, 1997, p. 117). It is us humans who derive *meaning* from those signs—those bit collections. The central concept here is that *signs represent objects*. The signs are not the objects themselves.

Signs can represent real objects and truth. *Signs* can also represent falsehoods, bad ideas, and foolish and unethical behavior. C. S. Peirce and I disagree with Marshall McLuhan (1964). The medium is ***not*** the message. The medium *represents* the message, just as words and pictures

do likewise in books, television, movies, and on our computer displays. Our minds make meaning from these mediated messages. As I wrote in the PDK Fastback:

> *The content is what is shared between successive generations. Students must interact with content in order to construct understandings and their personal values and beliefs. Content is not just math, English, or biology. And content is not found in books or computer programs or on the television screen either. Content is the stuff of human thoughts, ideas, aspirations, feelings, and attitudes. What is found in media such as books and TV are representations of content. The content may be symbolically coded in language only, or it may be conveyed through drama, for example.* (Frick, 1991, p. 15)

It is us humans who try to make sense of those signs and understand their meaning. We humans must determine what is true, what is good, and what is beautiful. That's one important reason why we need human teachers in education systems.

What is an Education System?

In *Restructuring Education Through Technology*, I described four essential components of an education system: teacher, student, content, and context, as well as the environment of an education system (surroundings). These fundamental ideas have not changed. An education system requires:

- One or more *teachers* to guide student learning;
- One or more *students* who intend to learn;
- Guidance of learning that occurs in a *context* (i.e., a setting which also includes *content* for learning) (https://educology.iu.edu/educationSystem.html)

An overarching idea is that an *education system* is first an *intentional system*. This idea is drawn from a broader view derived from general system theory (Thompson, 2006).

Note this conception of an *education system* consists of *universals*, not limited to time or place (https://educology.iu.edu/universals.html). Thus, *education systems* are not limited to schools or universities as we now know them.

- *Teachers* need not be limited to licensed school teachers or college professors.
- *Students* need not be restricted to young people attending a school or university.
- C*ontexts* for teaching and learning need not be classrooms in school buildings or on college campuses.
- *Content* need not be limited to traditional subjects of study in schools or universities such as mathematics, history, language arts, music, chemistry, biology, physics, etc.

These ideas will be illustrated with examples in the next sections. I will follow the original organization in *Restructuring Education Through Technology* (Frick, 1991), so that readers can more easily compare the current and former version:

- Teacher-student relationships
- Student-content relationships
- Teacher-content relationships
- Student-context relationships
- Teacher-context relationships
- Content-context relationships

Due to space constraints here, I will combine the "What If?" sections into one near the end of this article.

Teacher-Student Relationships

- Teachers continue to directly guide student learning face-to-face in classrooms in school and campus buildings; and via field trips with students outside of schools.

- Teachers directly guide student learning in their classes remotely and in real-time through online connections in ways that include synchronous chat and two-way video (e.g., Google Hangouts, FaceTime, Skype, Zoom).
- Teachers guide student learning in their classes by making recorded videos played back via the Internet (e.g., using course management systems such as Canvas, Blackboard, and Moodle); by making screencasts (e.g., voice over PowerPoint slides); by sending e-mail and text messages; by creating course websites; by contributing to online discussion forums; etc. Some of these can be very large online classes, referred to as MOOCs.
- Online degree programs are now offered. Students on the job can continue their education; working professionals can also moonlight as teachers in these programs—who may not have teaching licenses or advanced degrees but who are competent practitioners. My own IST department has offered online master's degrees since about 2000, and Indiana University's first online Ed.D. program started in 2013. Not only do our faculty teach online, but we also employ alumni with Ph.D.'s in IST who live and work elsewhere as instructors in some of our online courses.
- Online education programs also can facilitate a much greater diversity of students from different countries, cultures and ethnicities for teachers to guide. These programs further provide students with opportunities to learn from a far greater diversity of teachers. Both teachers and students can also be working in other jobs, raising their families at home, etc. For example, many students in the IST Ed.D. (doctoral) program are also employed in full-time jobs in business, industry, military, and higher education settings as instructional designers.

Student-Content Relationships

- We still have textbooks, magazines, newspapers, recorded movies, videos and music, etc. for students to use as resources for learning. Many of these have been merged into computer-radio-television-stereo-telephone devices that I described previously (Frick, 1997, p. 108) and can stream content from the Cloud via the Internet.
- *Augmented reality*: with portable devices such as smartphones and tablets, as well as head-mounted displays with GPS, it's possible to provide content overlays as students visit real-world contexts. For example, as we visit the Sistine Chapel, we can learn more about it on the spot with access to the Internet and a hand-held device (https://en.wikipedia.org/wiki/Sistine_Chapel). And virtual tours are now a reality. I did one "under water" using a head-mounted VR display at the *Living Computers Museum* in Seattle, WA, a few years ago. I often use Google Maps and Google Earth when I travel, in order to familiarize myself with new surroundings; and GPS is very helpful for getting me to places I've never been to.
- *Web search results*: Google search is possibly the best example of artificial intelligence thus far. Type in a few words, and we can often get a list of Web links to highly relevant documents or even a verbal answer to our question. The Google Page Rank methodology is a very powerful way to identify important websites which are pointed to by other important websites (capturing website creators' human judgment of what is relevant and important). The fastest way I can retrieve my professional vita is to type "ted frick" in the Google search box. Bingo—not to be confused with the golf swing instructor in Myrtle Beach with the same name! Nonetheless, we still have to be careful to judge the

quality of content in documents and websites we retrieve to determine their legitimacy (more on that below).

- *Siri, Alexa, Cortana, Google Assistant, Dragon Naturally Speaking, and other agents with voice recognition*: These are yet another way to browse the Web via AI voice recognition techniques, also with similar limitations to Web searches with Google. Over 20 years ago, I identified some significant obstacles that might impede progress on voice recognition systems (Frick, 1997). While these systems are not perfect, they can be useful in specific contexts. I can often dictate short e-mails and text messages with few errors now, as long as I'm not using specialized technical language. My primary care physician dictates his notes to his laptop computer when I visit for a medical checkup. His system is trained to recognize medical terminology, and does a reasonably good job most of the time, he says.
- *Fingerprinting, face recognition, and other ways to identify unique individuals*: This is important not only for filtering access to digital devices for security reasons, but also for computer record keeping. Such digital fingerprinting is a boon for commercial advertisers. In addition to literal fingerprint ID's and face recognition with digital images, there are ways to do digital fingerprints by methods of web tracking even without cookies (e.g., see https://www.nytimes.com/2019/07/03/technology/personaltech/fingerprinting-track-devices-what-to-do.html). As an example, Google Analytics provides information about unique users of websites even though they never sign in or register. Through a combination of digital tidbits and breadcrumbs, Google algorithms can determine when the same user returns to do more on a website. And by compiling information on the

same individual, reasonable inferences can be made about one's age, gender, interests, etc. While software for incognito browsing is now available in an attempt to counteract such tracking methods, let's not kid ourselves. Web servers return requested information to the specific IP address where the device is located, and browser requests for Web pages include some further technical information about the device itself, browser, OS, etc. That's how the Web works. Ever wonder why ads for things you were recently shopping for on Amazon.com turn up in Facebook and Rolling Stone Magazine? On the other hand, such approaches can now be implemented for adaptive computer-mediated learning, as I described 30 years ago (Frick, 1990). As more is learned about a particular student, a computer algorithm can select or adapt content appropriate for that person.

- *Virtual reality, virtual worlds, simulations, video games, and animated movies*: We continue to push the frontiers of what technology can do. Some of the best simulators have been developed for commercial airline and military pilots. These are extremely valuable for allowing pilots to react and respond to situations that rarely occur in real life, to practice emergency procedures, and to learn from their mistakes without destroying expensive planes and loss of human lives. Pixar movies have created digital stories through animation raised to new levels. Telling stories can be educational—a way to share human culture at least since ancient times when we sat around campfires. Video games have become a popular genre for learners to explore virtual worlds, and can be educational as well as entertaining—depending on the focus, e.g., Civilization: https://en.wikipedia.org/wiki/Civilization_VI.
- *Student creation of content*: This is relatively easy now using current technologies. Not only can students write papers using their laptop computers or Chromebooks, they can

also create video stories with smartphones or digital cameras, edit them, and post their work online. For example, a teacher at a local middle school in Bloomington, Indiana, has been motivating his students to create digital documentaries on significant issues. Their videos have won awards nationally for their quality, depth of coverage, and creativity. I was pleasantly surprised to see a group of those middle school students get off a bus in Anaheim, CA, at the AECT Conference Hotel some years ago. They were all wearing same-colored t-shirts with their school name printed on them. They had travelled there to show off their work at the *AECT International Student Media Festival*, and to learn more from professionals in the industry. Small world!

Teacher-Content Relationships

- Teachers can access content in the same ways as do students, described above.
- It is also now much easier for teachers to create their own content, e.g., make videos with a smartphone and upload to the Cloud for their students.
- There are useful software tools for teachers for making slide presentations, website resources, etc. Content management systems such as Canvas, Blackboard, and Moodle facilitate teacher collection of learning resources for their students, posting their course syllabi, for making assignments and providing feedback on student work, managing discussion groups, using online gradebooks, and facilitating other class activities.
- Teachers can create content for guiding student learning beyond their own specific classes, such as computer tutorials and tests/quizzes, simulations, and games. For example, I directed IST student development of our online *Plagiarism Tutorials and Tests* (https://plagiarism.iu.edu) and the *Diffusion Simulation Game* (https://diffusion.iu.edu). Web logs document that literally millions of students

worldwide have used these learning resources in the past 18 years. These resources are analogous to the printed textbook tradition in education, where some teachers have written textbooks that are used by many other teachers and their students.

Student-Context Relationships

- Students continue to physically attend formal classes in school buildings and on college campuses.
- Student can individually use portable digital devices (e.g., iPads, Chromebooks, laptop computers, smartphones) that run on batteries and connect wirelessly to local and remote networks, not only in school classrooms, but also for doing homework outside of school.
- Younger students who have not reached adulthood still need direct supervision by adults in environments that are safe.
- Adult students of all ages now can take formal classes online, where they can earn diplomas, degrees, and certificates from home or from just about anywhere with Internet access.
- Students live in an environment and culture that now includes vast resources available through the Internet. This is the new "library". This environment is accessible through their digital devices running apps such as web browsers and messaging systems. Most of these vast resources are unfiltered and uncurated—so there is a quality issue—it can often be difficult to determine what is trustworthy, safe, or accurate. For example, there are "fake news" publications, pornographic websites, and many other unsuitable materials.
- Students can interact with their peers, friends, and others through social media—including Facebook, Instagram, Snapchat, Twitter, etc. Unfortunately, sexual predators and bullies also have access to these apps.

- There are many ongoing distractions in the environment that can disrupt student attention to learning activities. Instead of noisy peers in a school classroom, students at other times and places are frequently interrupted by notifications from their devices—e.g., new text messages, e-mails, likes or dislikes of their social media posts, news alerts, etc. These notifications can occur day and night, just about anywhere there is access to the Internet. Unfortunately, these interruptions can also distract drivers and cause fatal automobile accidents.

Teacher-Context Relationships

- When I wrote the Fastback in 1990, many schools were struggling to buy computers for their teachers and students. Machines were often put in school computer labs and shared among classes. Teachers were largely cut off from the rest of the world when in their classrooms (no wi-fi, no Internet access, no phones in the classroom). My, how things have changed! Many teachers currently have ready access to Internet-connected devices in their classrooms.
- Blackboards, marker boards, and overhead projectors have been supplemented or replaced by digital projection devices (LCD/LED projectors) and large display devices (such as flat-screen TVs) for group viewing.
- Teachers can now virtually bring in guest teachers via video conferencing. Teachers can also take their students on virtual field trips, while remaining physically in school classrooms.
- Teachers can continue their own learning via online programs without taking a leave of absence from their jobs or be limited to taking courses during summers.

- Teachers are connected digitally to the "outside" world, as are students described above. Teachers also deal with all the distractions and interruptions, as do students. Teachers also face a context that includes billions of unfiltered and uncurated resources.
- Perhaps the greatest context change is that teachers can now teach from just about anywhere to adult students also located just about anywhere—if both have online access. Teachers are freed from the constraints of needing to be in a classroom with students physically present at the same time. For example, since 2000 I have taught formal classes online from home, as well as when travelling. And students can take classes from home, dorm rooms, or elsewhere outside school or campus classroom buildings.

Content-Context Relationships

- *Digital content storage*: digital information can be stored in a variety of devices, either local or remote. On computer devices themselves we have had hard drives, solid-state drives (SSDs), DVD/CDs, floppy disks, thumb drives, SD cards, and the like. These are non-volatile storage, and so retain the digitally encoded information without an active power source. More and more now, storage is available on remote devices accessible through the Internet. Google Drive, iCloud, OneDrive, Amazon Web Services, Box, and similar services are available to users for online storage, which is sometimes referred to as the Cloud. The advantage of remote storage systems is that someone else maintains them and does regular backups. Also if any content is changed, then the changes become available to teachers and students immediately—unlike traditional textbooks, which are relatively expensive to update, reprint, and replace. The disadvantage is that digital content stored on these devices requires an Internet connection for access, and if the file sizes are very large, faster transmission speeds are required for practical access.

- *Wikipedia*: Remote storage also makes feasible collaboration among users with Internet access and permission to make changes in content. Wikipedia and other shared hypermedia systems employ a community approach to content development. While there are some downsides to this kind of sharing, it does help develop consensus among users in order to get their facts correct—based on other established and reputable sources. Indeed, this approach has improved the overall accuracy of information in encyclopedias to eventually surpass that of well-established printed encyclopedias, such as *Britannica*. This is possible because there are observers worldwide who regularly monitor what is going on, and who have the power to modify the content.
- *Have nots*: People who live in rural areas or in poverty are significantly disadvantaged with respect to opportunities to use many of these digital technologies for accessing content. Broadband Internet is currently unavailable in many rural areas, although efforts are underway to improve matters. Slow transmission speeds make it impractical to download or stream very large files (e.g., video). In poverty-stricken areas, where schools, teachers, and student families lack financial resources to afford the needed digital infrastructure and devices, many of the activities described above are beyond their reach.

What If? What Could Be?

Artificial intelligence (AI) and robot teachers could be in future education systems. We already have some examples of AI, such as Siri and Alexa. Just verbally ask a question, and in seconds there is an answer or a list of likely resources. As mentioned earlier, the Google search engine is likely the best current example of AI. It is remarkable how well Google searches can work, speaking from my own experience. This raises the question that I posed over 20 years

ago: "Will these globally interconnected, multimedia computer-television-telephone-stereo-radio systems largely replace teachers? Will these multimedia tutoring systems be intelligent enough to do so?" (Frick, 1997, p. 108).

Science fiction writers have envisioned some futuristic scenarios. For example, Arthur C. Clarke (1968) included HAL as a central character in *2001: A Space Odyssey*. The astronauts on the outer space mission conversed in natural language with HAL, played chess games, and queried HAL about ship operations, who was central to running the spaceship. In *The Moon is a Harsh Mistress*, Robert Heinlein (1966) described Mycroft Holmes (Mike), which was a sentient supercomputer who conversed with humans in natural language, could program itself, and was smart enough to help rebels living on the moon to overthrow the Lunar Authority, an arm of government controlled from planet earth. Mike and HAL were stationary computers.

In *The Robots of Dawn* (Azimov, 1983), Daneel and Giskard were robots who moved around. Central to the plot, they helped a human detective solve a murder case—the death of another robot. Daneel was embodied in humanoid form, nearly indistinguishable from actual humans in form and function, including sex. And while Daneel was incredibly intelligent, Giskard, who was not humanoid, turned out to be even more sentient. This and other science fiction novels by Isaac Azimov were famous for introducing the "three laws of robotics"—prime directives for robots to follow: not harming human beings, following their orders, and self-preservation (https://en.wikipedia.org/wiki/Laws_of_robotics). In *3001: The Final Odyssey* Clarke (1997) provided a further futuristic sci-fi scenario. "Braincaps" and "brainboxes" were sophisticated devices that could rapidly download knowledge to a human brain, essentially providing an instant education. Braincaps also allowed a human to have imaginary

experiences—a virtual reality that was just as real as dreams, while interacting with others with their own virtual avatars.

In non-fiction, Ray Kurzweil envisions a future where humans and robots meld, transcending biology (e.g., *The Singularity Is Near* (2005) and *The Age of Spiritual Machines* (1999)). He discusses six epochs of evolution, starting from physics and chemistry and ending with the universe waking up. He predicts that intelligence will evolve far beyond its current embodiment in organic forms, not unlike the underlying premise of Clark's first odyssey novel, centered around the mystery of intelligent, powerful monoliths buried on Earth's moon and orbiting Jupiter.

These are but a few images of humankind's future. Could future education systems turn out in any of these ways? Will we someday have humanoid robots, braincaps, or literally a universal mind? Rather than trying to predict what could be, I next discuss what education *should be*, taking a philosophical position.

Conclusion: What Should Be?

Education is vital to society. I have spent most of my lifetime trying to improve education, with the hope that this will improve the quality of life. In fact, that's how I define 'worthwhile education for everyone':

> *Worthwhile education for everyone is the goal of making intrinsically good and instrumentally good education accessible to everyone everywhere.*
>
> *Every human being has a right to worthwhile education. We can do this together.*
>
> *Why? To:*
>
> - *Enhance the quality of life.*
> - *Reduce inequality.*
> - *Minimize suffering.*

- *Maximize overall good.*

How?

- *Connect good teachers with students to help them learn worthwhile content.*
- *Provide contexts to support these connections for teaching and learning.*
- *Provide a viable way to sustain worthwhile education for everyone.*

(https://educology.iu.edu/worthwhileEducation.html)

I have found the conclusion reached by Greenspan and Benderly (1997) to get to the heart of the matter in education:

> *Computers may be able to perform certain cognitive operations, even more effectively, and certainly faster, than humans. But unless they acquire the ability to experience and react to emotion, silicon chips will be unable to exercise intelligent discrimination…. What separates human intelligence from that of computers, robots, androids, and any other cyber-creatures we can imagine, is the fact that we possess a nervous system capable of—indeed specifically designed for—generating and evaluation of affect…. Unless and until we solve the problem of creating living cellular reactivity and affects, as well as the capacity to abstract patterns of affects, in an artificial form, no machine will think in a truly human way.* (pp. 126-127)

Thus, human teachers are essential to education. It is vital that teachers and students form emotional bonds. This is the most important relationship in education systems that must be nurtured, no matter how technology might evolve.

Coda

In 1990, I did not anticipate many of the bad things the same digital technologies would enable. In hindsight, I was naïve and overly optimistic.

I knew that tools can be used for both good and bad purposes. For example, knives are useful for cutting and preparing food. Knives are also used to maim and kill people. Assault weapons our military soldiers use for protecting us from enemies are also used for mass

shootings of innocent people. Suicide bombers from terrorist organizations likewise slaughter innocent bystanders. *Intentions of human beings who use these tools matter the most.*

The same is true for digital computers and information technologies. We can use them to empower teaching and learning. These technologies allow us to educate in ways that we could not do without them.

We can also use those same technologies for disrupting democracies, for duping masses of people into believing falsehoods, and goading us to fight with each other—through carefully orchestrated propaganda campaigns. Through the Internet, cyber criminals can use computer technologies to steal our money and identities from half-way around the world. We try to keep safe from computer viruses and ransomware. In addition to pick pockets, we now must watch out for phishing. *Grand Theft Auto* is not only a felony, but also a popular video game. Cookies continue to be a sweet edible, but also have become the small pieces of data that many websites store on our computers as we browse. Digitally shared Web cookies are used to track where, when, and what we browse on the Web. These data are in turn used by businesses for customizing advertisements tailored to match our unique profiles. These data can also be used for more clandestine purposes—e.g., as tools for influencing democratic election outcomes, that is, how we vote—by determining which political messages we are individually more receptive to.

Drones and security cameras in public spaces spy on us too. So can orbiting satellite cameras with powerful zoom lenses. David Brin (1998) reminded us of the millennia-old question in *The Transparent Society*, "Will common folk have, and exercise, a sovereign power to watch the watchers?" (p. 9). *Quis custodiet ipsos custodes?*

(https://en.wikipedia.org/wiki/Quis_custodiet_ipsos_custodes%3F). Networked security cameras are now commonplace both inside and outside businesses and our homes. Phone companies track where our cellular phones go, as we carry them around. In addition to stationary cameras, many people can now use their smartphones to shoot video just about anywhere, yet another way our privacy is impacted. And easily upload their videos to YouTube. About one billion hours of YouTube videos are viewed daily: https://www.brandwatch.com/blog/youtube-stats/ . In 1992 I argued that commercial TV was the most powerful education system in the world with no one in charge (https://tedfrick.sitehost.iu.edu/edsys.html). It now looks like YouTube is the front-runner.

These digital technologies can be used for both good and bad—they are double-edged swords. Is 2020 turning into George Orwell's *1984*? I hope not!

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