Interrogating the Smartphone:
Teaching through Technoskeptical Questions

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When we ask students which technologies most affect their lives, the smartphone stands out. Though it has existed for barely two decades, many people—young and old—can hardly imagine their lives without this technology.

The astoundingly diverse purposes of the smartphone—from interpersonal communication to information access to direction navigation—are transformative, however, its unintended effects are easy to overlook. Smartphone use nudges individuals toward certain behaviors and understandings. Texting shifts ideas of communication; social media shifts ideas of news and information; and GPS shifts ideas of place and surveillance. School communities often debate policies for the role of smartphones in schools, but their role as objects of study is less commonly discussed.

Technology is a crucial topic for social studies because technological change is increasingly rapid, pervasive, and invasive. However, our recent study of K-12 social studies curriculum standards from 10 states found that the standards offered teachers little explicit guidance for teaching about trade-offs or other complexities of technology.[1] Despite nearly one thousand references to technology, many of these references were exceedingly general or broadly categorical ("transportation"). More specific references were most frequently related to industry or economic growth. Technologies were often framed in neutral and sometimes exclusively positive terms. Only rarely, in particular states, did references include critical perspectives of the effects of a technology. Standards often stressed basic development of new technologies and stopped short of critical inquiry into collateral outcomes or consequences—benefits and drawbacks or disproportionate impacts on people or groups.

A notable exception is the Science, Technology, and Society theme of the National Council for the Social Studies (NCSS) curriculum standards, which encourages substantive inquiry into the effects of technology.[2] Social studies teachers can build on this through "technoskeptical" inquiry. A technoskeptical disposition doesn't automatically equate technological advancement with social progress. Instead, technoskeptical inquiry considers collateral, unintended, and disproportionate effects of technology over time. We use smartphones as an illustrative example of our question-based approach for teaching about technology through technoskeptical questions.

Activities for Technoskeptical Inquiry with Students

1. **Prior Knowledge**: Inquire with students into different definitions of "technology"
2. **Background**: Investigate the technical dimension of a technology's larger history
3. **Application**: Inquire into collateral effects of technology through five questions

Prior Knowledge: Inquiry into Defining Technology

The first step in preparing students for critical inquiry about technology is to form working definitions by asking students, *How should we define technology?* Technology is a term that has meant

different things to different people over time. Students will offer varying, thoughtful definitions. Teachers might share with students that the origins of the term go back to ancient Greek–*tekhne*, meaning craftwork. For many people today, technology is synonymous with tools. We have used one possible definition: Technology is any kind of tool, mechanical or electronic, that increases or replaces the physical or mental capacities of humans and animals. Many people have a *recentness bias* that, in the words of computer scientist Alan Kay, "technology is anything invented after you were born." Teachers should encourage students to consider how older technologies still shape their lives.

Many people also tend to associate technology with "progress" because the intended purposes of technology are often more obvious than unintended effects. To counter this, we encourage students to suspend their judgment and consider: *Are we sure the newer technologies are better than what came before?* As an opening activity, have students examine critical quotes about technology. Here are three examples:

- We shape our tools and thereafter our tools shape us. – John Culkin, *Saturday Review*, 1967

- Technology giveth and technology taketh away. – Neil Postman, *Technopoly*, 1992

- On the Internet and in our everyday uses of technology, discrimination is embedded in computer code…. – Safiya Umoja Noble, *Algorithms of Oppression*, 2018

Technical Background: Where Did the Smartphone Come From?
The next step is to help students understand how a technology is integrated with prior or subsequent technologies so they can evaluate long-term social implications. This requires

Technical Background of the Smartphone and Related Developments

Printing. Moveable type originated in 11th-century China; paved the way for the Gutenburg printing press in Europe, c. 1450. Linked to text fonts still in use digitally today.

Telegraph. First long-distance electronic communication invented in Europe and the U.S. (1830s). Sent signals along electric wire relays. In 1870s, the telephone, developed in the U.S., converted voice into and from electronic signals.

Radio. Wireless sound transmission over radio frequencies of electromagnetic spectrum. In 1890s Italy, Guglielmo Marconi invented the radio. By the 1920s, the radio was a household U.S. consumer product, receiving signals from stations broadcasting in amplitude modulation (AM) and later improved frequency modulation (FM). This led to wireless communication.

Television. Wireless transmission of motion by rapidly scanning EM signals to convert into images projected on a screen. Became household consumer product in the U.S. from 1930s-1960s, receiving signals broadcast regionally by government-licensed commercial TV stations. Cathode ray tubes later replaced by liquid crystal displays (LCD) and light emitting diodes (LED), resulting in sharper images on larger and lighter screens.

Satellites. Electronic devices in orbit that relay radio signals and images by EM transmissions. First launched by Soviet Union in 1957 (Sputnik). Networks of government and commercial satellites launched by the U.S. after 1960. Made possible planet-wide wireless communication.

Computers. Electronic computing machines developed for code breaking in WWII and nuclear programs in 1950s. Miniaturization of transistors and processors (microchips) led to more powerful personal computers in the U.S. starting in the 1970s. Networks of computers sponsored by the U.S. military in 1960s expanded by 1990s into the worldwide Internet. In 21st century, tiny semiconductor chips enabled very powerful yet small, lightweight digital devices.

exploring the background on where the technology came from and how it fits into wider changes and developments. Technologies are never completely new. They emerge (gradually or suddenly) from a longer pattern in which new developments displaced or disrupted existing technologies. How a technology emerged from precursor inventions or developments is not always obvious. It is reasonable to assume the smartphone simply emerged from the telephone of the twentieth century, but the traditional landline contributed little to the smartphone beyond the shape of the green pickup (receiver) and red hang-up (cradle) buttons. The original telephone is an end technology replaced by wireless phones; only the wireless technology was integrated into the smartphone.

The technical background outlined in the sidebar on p. 314 sheds light on the fact that the smartphone is essentially a pocket-sized, internet-enabled, touch-screen personal computer with wireless digital communication. Teachers can use youth reference books, primary documents, news reports, and informational Web videos to equip students with a wider history of precursor technologies.[3] Students will then be able to examine broader implications and form generalizations about the technological changes.

Application: Five Technoskeptical Questions about Smartphones

The culminating step in this inquiry lesson is to explore five critical questions about technology with students. We adapted these questions from Neil Postman's ideas about technological change.[4] Our questions encourage a technoskeptical outlook that invites inquiry, curiosity, and collateral thinking by bringing attention to technologies as causal or contributing factors to historical and societal change. Teachers can use (or adapt) these questions whenever they examine other technologies. This lesson introduces students to technoskeptical questions with the smartphone, a technology with which they already have substantive experience. Teachers may choose to assign questions to individual students or ask small groups to research and share their findings. Below, we offer further explanation and possible answers for each question.

Question 1. *What does society give up for the benefits of this technology?* All technological change involves trade-offs. Identifying the trade-offs for society can help students see beyond intended benefits to evaluate negative costs or disruptive effects of a new technological development displacing existing technologies and ways of life. By exploring this question, students may

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Consequences of the Smartphone for Inquiry

- These technologies brought economic growth and benefits to those who could afford them, but they were disruptive to others. Radio disrupted the existing telegraphy industry, and its network of physical wires. Television disrupted the commercial radio industry. Personal computers and the Internet transformed the economy and people's lives—from entertainment to education.

- The commercial advertising model and its manipulative effects have followed audiences from radio, to TV, to the Internet, and now to streaming.

- Smartphones, like many other electronic devices, increasingly rely on exploited laborers to mine cobalt from the Democratic Republic of Congo and assemble products in China.*

- Cost of electronic devices decreased over time, but decades of outmoded radios, TVs, and computers pollute the environment with hazardous "e-waste."**

- By the early 2020s, there were more than 3.5 billion smartphone users worldwide. How to safely dispose of or recycle billions of devices upgraded each year is a major environmental challenge.

* For details see Amnesty International, "Is My Phone Powered by Child Labor?" **www.amnesty.org/en/latest/campaigns/2016/06/drc-cobalt-child-labour.**

** Environmental Protection Agency, "Cleaning Up Electronic Waste (E-Waste)," **www.epa.gov/international-cooperation/cleaning-electronic-waste-e-waste.**

conclude that the benefits to society are worth the costs, but they also may reevaluate their own relationship with a technology and consider when habits, policies, or regulations could limit the harmful effects of technological change.

Q1. Application Activity: Break class up into small groups to discuss the benefits and trade-offs of the widespread adoption of smartphones. To stimulate discussion, provide the students with excerpts from the example source below or other sources cited in this article.

There are many other possible tensions that teachers can guide students to consider: smartphones have benefited society by connecting most people to instant information, communication, and commerce almost anywhere at any time. Fear of being lost, stranded, or cut off from loved ones in emergencies has largely evaporated. As a trade-off, immediacy of communication and online access has resulted in the expectation that people are always connected and available. Constant access to social apps such as Instagram can lead to anxiety, the constant threat of bullying, or depression, particularly in teen girls. Smartphones also can bring distraction when attention is caught up in texting.* Workers are increasingly 'on call' for their jobs. Large numbers of citizens are persistently on social media and thus react to events or rumors instantly, often with short messages and little context. Digital mapping apps, such as Google Maps, result in people no longer taking the time to learn how to navigate places. Such acceleration costs society slower, calmer deliberation and shifts civic discourse from the physical town square of human interaction to instant and often anonymous digital platforms.

Example Source: "Facebook Knows Instagram Is Toxic for Teen Girls, Company Documents Show" by Georgia Wells, Jeff Horowitz, and Deepa Seetharaman. *Wall Street Journal* (Sept. 14, 2021).

*   Hari, Johann, *Stolen Focus: Why You Can't Pay Attention–and How to Think Deeply Again* (Crown Publishing Group, 2022).

Question 2. *Who is harmed and who benefits from the technology?* Technological change inevitably creates winners and losers. Who benefits and who loses are obvious in some cases but at other times obscured. When large majorities of people receive some benefit, those who do not or who are harmed are easier to overlook. Many new industrial technologies in the past two centuries have expanded the wealth and power of a relative few without always benefiting the common good. Technologies can result in disparate, differential, and disproportionate effects for different groups, particularly historically and contemporarily marginalized groups. Technologies can discriminate by design or in their application as has been the case with Kodak cameras, facial recognition software, or even touchless soap dispensers that failed to recognize darker skin.[5]

Q2. Application Activity: Set-up learning stations around your classroom with each focused on one topic/factor: race, class, age, nationality, and environment. As student groups move through, direct them to contribute to a list of who benefits and who is harmed in different ways by the widespread adoption of smartphones. You can make available at each station excerpts from media sources contained in this article.

Possible tensions that teachers might guide students to consider: smartphones benefit people who can afford to buy them and the digital service required. Widespread ownership of smartphones has allowed governments and institutions to shift many services and activities online for on-the-go access and to close physical in-person sites. As a consequence, those who cannot afford to buy the necessary upgraded device or digital service may be excluded from civic services, from public parking to petitioning their government. The collection of digital data from smartphones has resulted in increased digital surveillance, including new threats to civil liberties and rights particularly for groups most often targeted.* The environment and local populations are harmed by mining of rare earth metals needed to make the phones and their batteries and by the "e-waste" of obsolete smartphones commonly recycled in developing countries by desperately poor people risking their health to salvage valuable materials for resale.

*   An example is from Jon Schuppe, "Cellphone dragnet used to find bank robbery suspect was Unconstitutional, Judge Says," NBC News (March 7, 2022)

Question 3. *What does the technology need?* New technologies change societies and the people who use them. Technological development is not a passive process. As a new technology

transforms its users into a new kind of citizen or worker, the technology also alters society. For instance, mass production of automobiles in the 1900s turned residents of local communities into "motorists" and eventually "suburbanites" while pedestrians who did not use or could not afford automobiles had to live near and walk across dangerous spaces reshaped by roads and highways. Similarly, people may choose not to be on social media but still live in a society whose politics and culture are transformed by it.

Q3. Application Activity: In table groups, provide students with a map of cellular coverage, digital connectivity, and smartphone vendors in their locality. Instruct students to look at the map and reflect on what the smartphone needs from people in order to serve its function. Invite students to consider how that changes communities.

Possible tensions that teachers might guide students to consider: smartphones need society to provide infrastructure and maintenance. Digital communication requires a system of satellites in space and a vast network of cellular towers on Earth to convey signals. Corporations pay to build some infrastructure but rely on national, regional, and local governments to build and especially maintain much of it. The spread of smartphones needs a commercial industry to market them and convince people to accept built-in obsolescence and regular turnover of upgrades. Perhaps most of all, smartphones need time and attention. They need society to enable masses of people to be constantly tethered to digital access and the consumption of digital data. Smartphones need connected people.

Question 4. *What are the unintended or unexpected changes caused by the technology?* New technologies have a ripple effect that changes other things, too. These changes can be unpredictable and enduring. Like dye that irrevocably colors the water in which it is dropped, a technological change is not simply an addition on top of what has come before. Even technologies that have had many positive effects for society can have collateral or disproportionate effects. For instance, urban sanitation (such as wastewater management) has considerable environmental impact.[6] Powered cleaning appliances that were

supposed to be "labor saving" devices led instead to societal expectations that mothers maintain higher standards of cleanliness.[7]

Q4. Application Activity: Jigsaw students into new groups, so that each consists of at least one student from each of the original groups. Direct the new groups, using ideas and reflections from their previous groups, to generate a list of "ripple effects" that the widespread adoption of smartphones has had on society, culture, politics, the economy, and health.

Tensions that teachers might guide students to consider: smartphones were not initially viewed as a modern necessity. Many Americans already had functional cellular flip-phones with internet connection. However, the smartphone's touchscreen and vast number of digital "apps" revolutionized how people used phones. More people are now spending time watching their smartphone screens, sometimes replacing the need for a traditional personal computer or even a television. Digital apps transformed society in unexpected ways. Streaming crashed the consumer market for buying music, which led many artists to sell their song rights to corporations. TikTok and Instagram have become ubiquitous social platforms that follow users wherever they go, which has led to "surveillance capitalism" that tracks and sells consumers' data for commercial and even political use. The day-to-day economy is rapidly shifting to digital commerce and banking that increasingly requires smartphone ownership. Despite its origins as a telephone, the smartphone entices people to trade text messages more and talk in person less.

Question 5. *Why is it difficult to imagine our world without the technology?* Technologies shift from new to accepted over time, and people start to see them as a natural part of their world. They are no longer just a tool or device but become a kind of social institution. Television did not remain a picture box but became "TV" culture. Automobiles did not remain a horseless carriage but became a status symbol that required purpose-built roadways, dividing the natural landscape and segregating cities racially. Once an older technology ceases to be seen as a strange, new intrusion, it is difficult to remain aware of its ongoing effects on society.

Conclusion

We are not recommending technoskeptical inquiry into smartphones because we believe the technology is inherently bad. All technologies bring benefits, at least for people in some places, but they also entail potentially negative effects, for other people in other places. As just one powerful example of a technology ripe for classroom inquiry, smartphones demonstrate the importance of collateral thinking about technology that does not overemphasize the positives or neglect the negatives. As we have tried to show, any technology is understood better if we do not view it in isolation but look at it in interplay with wider forces and factors integrated within a longer and larger history of technological changes. In the end, our relationship with technology is more complicated than the state standards that we examined. We hope these approaches open new avenues for inquiry about technology in your classroom.

Notes

1. Daniel G. Krutka, Scott Alan Metzger, and Zackary Seitz, "Technology Inevitably Involves Trade-offs: The Framing of Technology in Social Studies Standards," *Theory & Research in Social Education* (2022). DOI: 10.1080/00933104.2022.2042444

2. See **www.socialstudies.org/national-curriculum-standards-social-studies-chapter-2-themes-social-studies**

3. Teachers can find resources to use with students in the classroom for examining some of these technological developments, including a longer history of smartphone apps, at **www.civicsoftechnology.org/smartphone**, **www.civicsoftechnology.org** curriculum, and **www.civicsoftechnology.org/technology-quotes-activity**

4. Neil Postman, "Five Things We Need to Know about Technological Change," (Address delivered in Denver, Colorado, March 28, 1998), **https://web.cs.ucdavis.edu/~rogaway/classes/188/materials/postman.pdf**. For a deeper dive see Postman, *Technopoly: The Surrender of Culture to Technology* (Vintage, 1992).

5. Ruha Benjamin, *Race after Technology: Abolitionist Tools for the New Jim Code* (Polity, 2019).

6. Steven Johnson, *How We Got to Now: Six Innovations that Made the Modern World* (Riverhead Books, 2015).

7. Ruth Schwartz Cowan, *More Work for Mother* (BasicBooks, 1983).

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