

# Impacts of Computing

## Grades K-2

Computing affects many aspects of the world in both positive and negative ways at local, national, and global levels. Individuals and communities influence computing through their behaviors and cultural and social interactions, and in turn, computing influences new cultural practices. An informed and responsible person should understand the social implications of the digital world, including equity and access to computing.

Culture	Social Interactions	Safety, Law & Ethics
<b>1A-IC-16</b> Compare how people live and work before and after the implementation or adoption of new computing technology.	<b>1A-IC-17</b> Work respectfully and responsibly with others online.	<b>1A-IC-18</b> Keep login information private, and log off of devices appropriately.
Computing technology has positively and negatively changed the way people live and work. In the past, if students wanted to read about a topic, they needed access to a library to find a book about it. Today, students can view and read information on the Internet about a topic or they can download e-books about it directly to a device. Such information may be available in more than one language and could be read to a student, allowing for great accessibility.	Online communication facilitates positive interactions, such as sharing ideas with many people, but the public and anonymous nature of online communication also allows intimidating and inappropriate behavior in the form of cyberbullying. Students could share their work on blogs or in other collaborative spaces online, taking care to avoid sharing information that is inappropriate or that could personally identify them to others.  Students could provide feedback to others on their work in a kind and respectful manner and could tell an adult if others are sharing things they should not share or are treating others in an unkind or disrespectful manner on online collaborative spaces.	People use computing technology in ways that can help or hurt themselves or others. Harmful behaviors, such as sharing private information and leaving public devices logged in should be recognized and avoided.

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Culture		Social Interactions	Safety, Law & Ethics
<b>1B-IC-18</b> Discuss computing technologies that have changed the world, and express how those technologies influence, and are influenced by, cultural practices.	<b>1B-IC-19</b> Brainstorm ways to improve the accessibility and usability of technology products for the diverse needs and wants of users.	<b>1B-IC-20</b> Seek diverse perspectives for the purpose of improving computational artifacts.	<b>1B-IC-21</b> Use public domain or creative commons media, and refrain from copying or using material created by others without permission.
New computing technology is created and existing technologies are modified for many reasons, including to increase their benefits, decrease their risks, and meet societal needs. Students, with guidance from their teacher, should discuss topics that relate to the history of technology and the changes in the world due to technology. Topics could be based on current news content, such as robotics, wireless Internet, mobile computing devices, GPS systems, wearable computing, or how social media has influenced social and political changes.	The development and modification of computing technology are driven by people’s needs and wants and can affect groups differently. Anticipating the needs and wants of diverse end users requires students to purposefully consider potential perspectives of users with different backgrounds, ability levels, points of view, and disabilities. For example, students may consider using both speech and text when they wish to convey information in a game. They may also wish to vary the types of programs they create, knowing that not everyone shares their own tastes.	Computing provides the possibility for collaboration and sharing of ideas and allows the benefit of diverse perspectives. For example, students could seek feedback from other groups in their class or students at another grade level. Or, with guidance from their teacher, they could use video conferencing tools or other online collaborative spaces, such as blogs, wikis, forums, or website comments, to gather feedback from individuals and groups about programming projects.	Ethical complications arise from the opportunities provided by computing. The ease of sending and receiving copies of media on the Internet, such as video, photos, and music, creates the opportunity for unauthorized use, such as online piracy, and disregard of copyrights. Students should consider the licenses on computational artifacts that they wish to use. For example, the license on a downloaded image or audio file may have restrictions that prohibit modification, require attribution, or prohibit use entirely.

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## Grades 6-8

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Culture	
<b>2-IC-20</b> Compare tradeoffs associated with computing technologies that affect people’s everyday activities and career options.	Advancements in computer technology are neither wholly positive nor negative. However, the ways that people use computing technologies have tradeoffs. Students should consider current events related to broad ideas, including privacy, communication, and automation. For example, driverless cars can increase convenience and reduce accidents, but they are also susceptible to hacking. The emerging industry will reduce the number of taxi and shared-ride drivers, but will create more software engineering and cybersecurity jobs.
<b>2-IC-21</b> Discuss issues of bias and accessibility in the design of existing technologies.	Students should test and discuss the usability of various technology tools (e.g., apps, games, and devices) with the teacher’s guidance. For example, facial recognition software that works better for lighter skin tones was likely developed with a homogeneous testing group and could be improved by sampling a more diverse population. When discussing accessibility, students may notice that allowing a user to change font sizes and colors will not only make an interface usable for people with low vision but also benefits users in various situations, such as in bright daylight or a dark room.

Social Interactions	
<b>2-IC-22</b> Collaborate with many contributors through strategies such as crowdsourcing or surveys when creating a computational artifact.	Crowdsourcing is gathering services, ideas, or content from a large group of people, especially from the online community. It can be done at the local level (e.g., classroom or school) or global level (e.g., age-appropriate online communities, like Scratch and Minecraft). For example, a group of students could combine animations to create a digital community mosaic. They could also solicit feedback from many people though use of online communities and electronic surveys.

Safety, Law & Ethics	
<b>2-IC-23</b> Describe tradeoffs between allowing information to be public and keeping information private and secure.	Sharing information online can help establish, maintain, and strengthen connections between people. For example, it allows artists and designers to display their talents and reach a broad audience. However, security attacks often start with personal information that is publicly available online. Social engineering is based on tricking people into revealing sensitive information and can be thwarted by being wary of attacks, such as phishing and spoofing.

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Culture	
<b>3A-IC-24</b> Evaluate the ways computing impacts personal, ethical, social, economic, and cultural practices.	Computing may improve, harm, or maintain practices. Equity deficits, such as minimal exposure to computing, access to education, and training opportunities, are related to larger, systemic problems in society. Students should be able to evaluate the accessibility of a product to a broad group of end users, such as people who lack access to broadband or who have various disabilities. Students should also begin to identify potential bias during the design process to maximize accessibility in product design.
<b>3A-IC-25</b> Test and refine computational artifacts to reduce bias and equity deficits.	Biases could include incorrect assumptions developers have made about their user base. Equity deficits include minimal exposure to computing, access to education, and training opportunities. Students should begin to identify potential bias during the design process to maximize accessibility in product design and become aware of professionally accepted accessibility standards to evaluate computational artifacts for accessibility.
<b>3A-IC-26</b> Demonstrate ways a given algorithm applies to problems across disciplines.	Computation can share features with disciplines such as art and music by algorithmically translating human intention into an artifact. Students should be able to identify real-world problems that span multiple disciplines, such as increasing bike safety with new helmet technology, and that can be solved computationally.

Social Interactions	
<b>3A-IC-27</b> Use tools and methods for collaboration on a project to increase connectivity of people in different cultures and career fields.	Many aspects of society, especially careers, have been affected by the degree of communication afforded by computing. The increased connectivity between people in different cultures and in different career fields has changed the nature and content of many careers. Students should explore different collaborative tools and methods used to solicit input from team members, classmates, and others, such as participation in online forums or local communities. For example, students could compare ways different social media tools could help a team become more cohesive.

Safety, Law & Ethics	
<b>3A-IC-28</b> Explain the beneficial and harmful effects that intellectual property laws can have on innovation.	Laws govern many aspects of computing, such as privacy, data, property, information, and identity. These laws can have beneficial and harmful effects, such as expediting or delaying advancements in computing and protecting or infringing upon people’s rights. International differences in laws and ethics have implications for computing. For example, laws that mandate the blocking of some file-sharing websites may reduce online piracy but can restrict the right to access information. Firewalls can be used to block harmful viruses and malware but can also be used for media censorship. Students should be aware of intellectual property laws and be able to explain how they are used to protect the interests of innovators and how patent trolls abuse the laws for financial gain.
<b>3A-IC-29</b> Explain the privacy concerns related to the collection and generation of data through automated processes that may not be evident to users.	Data can be collected and aggregated across millions of people, even when they are not actively engaging with or physically near the data collection devices. This automated and non-evident collection can raise privacy concerns, such as social media sites mining an account even when the user is not online. Other examples include surveillance video used in a store to track customers for security or information about purchase habits or the monitoring of road traffic to change signals in real time to improve road efficiency without drivers being aware. Methods and devices for collecting data can differ by the amount of storage required, level of detail collected, and sampling rates.
<b>3A-IC-30</b> Evaluate the social and economic implications of privacy in the context of safety, law, or ethics.	Laws govern many aspects of computing, such as privacy, data, property, information, and identity. International differences in laws and ethics have implications for computing. Students might review case studies or current events which present an ethical dilemma when an individual’s right to privacy is at odds with the safety, security, or wellbeing of a community.

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Culture			Safety, Law & Ethics
<b>3B-IC-25</b> Evaluate computational artifacts to maximize their beneficial effects and minimize harmful effects on society.	<b>3B-IC-26</b> Evaluate the impact of equity, access, and influence on the distribution of computing resources in a global society.	<b>3B-IC-27</b> Predict how computational innovations that have revolutionized aspects of our culture might evolve.	<b>3B-IC-28</b> Debate laws and regulations that impact the development and use of software.
		Areas to consider might include education, healthcare, art/entertainment, and energy.	