

Explore educational technology

Teachers' Guide by **BOLD** and **Frontiers for Young Minds**

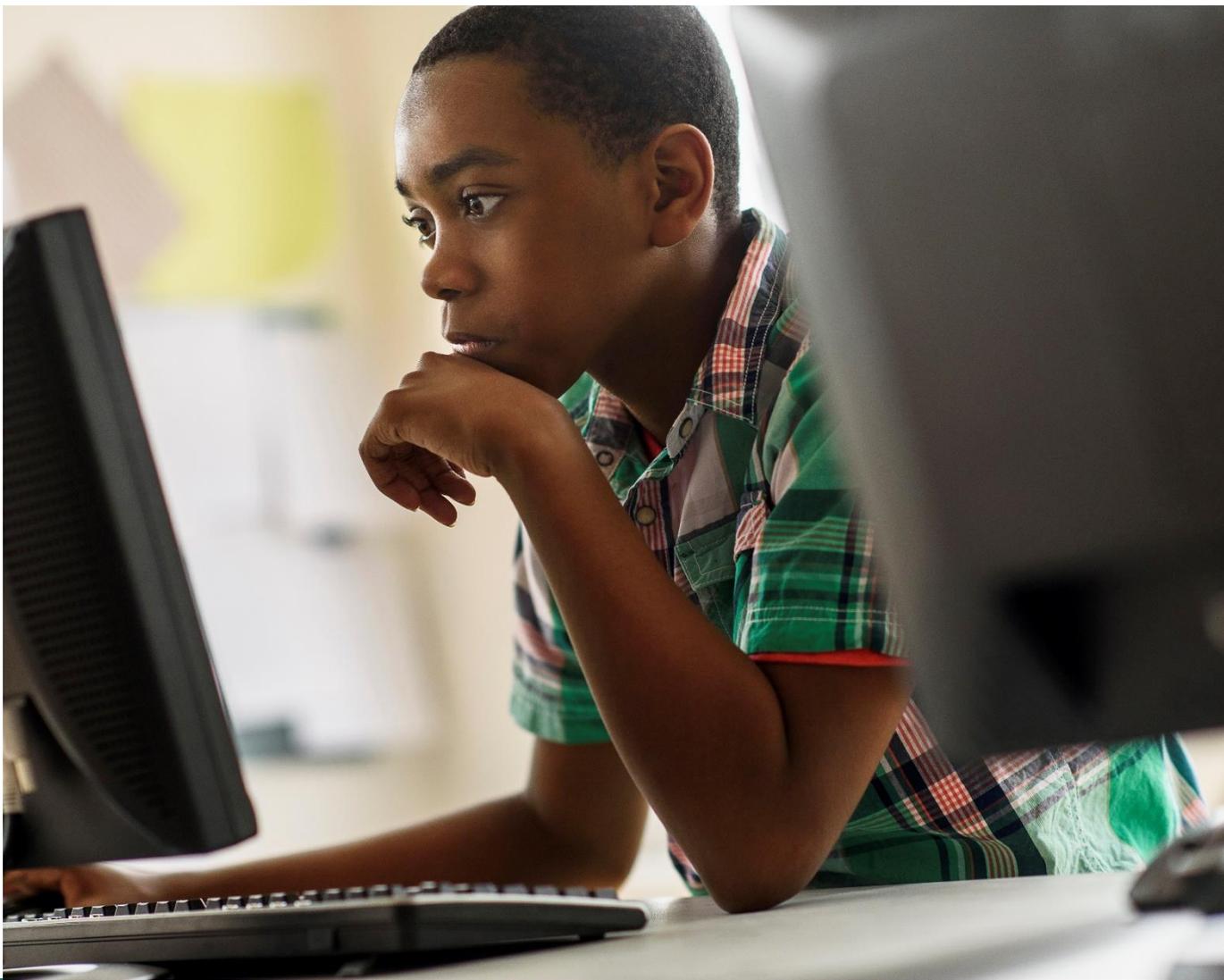


Table of contents

Explore educational technology	3
Quick overview of this Teachers' Guide pack	3
Part 1 BOLD articles: Learn the science	
Giving children agency in an era of artificial intelligence	5
Using edtech to personalize learning	8
The promising world of children's digital books	10
Explore more on BOLD	12
How technology can encourage collaborative learning	12
Ensuring EdTech is truly educational	12
Helping every child maximize their potential through personalized education	12
How can children exercise their agency?	12
Part 2 Explore technology with kids	
Articles for kids	14
Mind Games: Technology and the Developing Teenage Brain	14
How Do Kids and Grown-Ups Get Distracted in Everyday Situations?	14
Think Before You Type on Instagram!	14
Class activities	15
Discussion	15
Play	15
Group work	16
Creative writing	16
Answers	16
Discussion	17
Group work	17
Creative writing	18

Explore educational technology

Quick overview of this Teachers' Guide pack



[BOLD](#) and [Frontiers for Young Minds](#) have partnered to bring you this collection of insights into the latest scientific thinking around educational technology.

Included in this package, you will find:

1. Three articles from the BOLD network of researchers and writers, guiding you through the latest theory and science, with links to original research for further information.
2. Links to more resources to explore the topic further on BOLD, including a podcast episode.
3. Three relevant *Frontiers for Young Minds* articles that you can use to explore issues around educational technology with your class or other young learners.
4. Activities from the *Frontiers for Young Minds* team to try with your class to help them consolidate the ideas explored in the articles.

Key terminology

- **Agency:** the freedom to take control and make decisions.
- **Personalized learning:** educational materials and environments tailored to individual needs.
- **Self-regulated learning:** understanding, monitoring, and controlling one's own learning.

Part 1

BOLD articles: Learn the science

Three articles from the BOLD network of researchers and writers, guiding you through the latest theory and science, with links to original research for further information

Links to more resources to explore the topic further on BOLD, including a podcast episode

Giving children agency in an era of artificial intelligence

AI can empower children to control and monitor their learning



Technology and artificial intelligence (AI) impact many aspects of children's lives. AI is playing an ever more important role in both children's learning and their future work lives. Schools are embracing learning technologies that automate such tasks as providing feedback, selecting appropriate learning materials, and aligning curricula to the needs of students. At the same time, jobs increasingly rely on technology and AI. Young people may one day aspire to be a quantum machine learning analyst or personal memory curator, while older jobs such as cashier, mail carrier, or bookkeeper may disappear. Children today need to be prepared for these changes and able to collaborate with different forms of AI. We believe that children should be active participants when learning and living with AI, and this requires that they develop new capabilities and skills.

Self-regulated learning

If desirable work skills are taught at a young age, children can continue to develop them throughout their school years. One such skill is the control and monitoring of their own learning, also known as [self-regulated learning](#). This enables learners to proactively transform mental abilities into academic skills by self-generating thoughts, feelings, and behaviors that help them achieve their goals.

Students who can self-regulate their learning in this way are well equipped to navigate the faster pace of life in the age of AI. They can understand and manage their limitations during learning.

Yet although [self-regulated learning skills yield academic benefits](#), children are not given enough opportunities in school to explore and practice these skills with their teachers' support. When children use informal digital learning apps, they may have too much freedom, which results in unproductive learning. Paradoxically, they may receive too much support when using more formal educational technologies. Even more worrying is that AI may take more control in the future and fully automate the learning process, further suppressing opportunities for children to develop important self-regulated learning skills.

Learner and teacher agency

When children are developing self-regulated learning skills, [agency](#) – the freedom to take control of their learning – is central. But when working with digital educational tools, it is not always clear who is in charge. Is it the learner, the teacher, or the AI tool? Digital educational tools collect large amounts of data on learning, and AI can use this information to gain a deeper understanding of learning processes. Can we then also use data and AI algorithms to empower learners and teachers, and to provide them with agency? We believe so. But to achieve this, learners and teachers need stronger skills to make the most of AI support.

First, learners and teachers must be able to adapt to new situations and tasks, as societal changes are happening more frequently in the era of AI. More and more digital tools will be brought into classrooms, and teachers and students will need to collaborate as they look for ways to use them effectively.

Second, learners and teachers need to collaborate productively and proficiently with both humans and AI. When students work with technology in a group, positive social interactions and regulation skills like planning and monitoring are [key for learning](#).

Third, learners [need socio-emotional support](#) to tackle challenging problems. Teachers, caregivers, and technology can provide that support to help students understand and manage their own emotional states and motivation.

Lastly, students need to make [small-scale adaptations](#) in strategies in order to advance. For example, they can take initiative, set goals, and monitor themselves when working with others and with AI. All these skills and competencies are crucial for giving learners and teachers agency. We therefore believe that they should be a key focus in education systems.

Towards an AI that empowers learners and teachers

There are two approaches to the use of AI in educational settings. In one, teachers' tasks are offloaded to the AI system, which acts as a tutor for each student. Smart technology that tailors content to individual learners is already in widespread use in many classrooms, in the form of [Intelligent Tutor Systems](#). An alternative role for AI is to augment human intelligence and empower us to learn and teach more effectively. This approach, too, is already in practice, for example in [teacher dashboards](#) that provide real-time information about student performance, and in adaptive learning technologies that allow teachers and AI [to orchestrate classroom teaching](#) collaboratively.

We believe that this second approach is more effective at supporting students in their attempts to control and monitor their learning. The [learning path app](#), for example, promotes self-regulated learning by providing personalized visualisations of students' internal regulation processes. Learners and AI can work together and learn from each other: Learners explain to the AI how they monitor their learning, and the AI provides data and shows productive learning patterns to the learner. Through this interaction, both the student and the AI advance and adapt. Ultimately, if used well, AI can help learners control and monitor their own learning, enabling them to live and work successfully in the AI era.

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Using edtech to personalize learning

Successful learning personalization tools adapt to children as they change



Each learner tends to respond differently to the same instruction—and sometimes a given learner will respond differently at different times. We believe that personalized instruction, i.e. instruction that is adapted to individual learners, is a promising way to address the challenges of these differences. However, not all approaches to personalization are effective in improving educational outcomes. To be successful, they must consider more than just a learner's fixed characteristics.

The emergence of personalized learning

Personalized learning approaches fit the instruction to the individual learner, taking into account factors such as existing knowledge or motivation. The first to examine personalized learning from a psychological perspective was the psychologist Lev Vygotsky, in the early 20th century. He developed the concept of the "[zone of proximal development](#)," which encompasses all the tasks or challenges that learners cannot accomplish on their own, but can accomplish with support.

According to Vygotsky, optimal instruction is always situated within this zone. Clearly, these zones are very different for each learner. Teaching that addresses a group of learners all at the same time risks being too challenging for some learners and not challenging enough for others. Vygotsky provided good theoretical reasons for personalization, but does this approach actually improve learning?

Prominent evidence of the promise of personalized education came from Benjamin [Bloom](#) in the 1980s. Bloom found that one-on-one tutoring produced larger learning gains than did regular classroom instruction. This is generally assumed to be because tutors working one-on-one can

tailor their teaching so that it sits in the learner's zone of proximal development. The goal of personalized instruction is to bring the benefits of [one-on-one tutoring](#) to larger groups of learners, without providing an individual tutor for each.

One way to achieve this goal is through educational technology, such as an intelligent tutoring system. These digital systems assess several learner characteristics – often repeatedly – and adapt instruction to them. Intelligent tutoring systems are [more effective in improving educational outcomes](#) than are other forms of computer-assisted instruction, such as programs that simply present increasingly difficult tasks, without adapting to each learner.

In regular classroom instruction, too, repeatedly assessing learner knowledge [leads to greater learning gains](#), probably because teachers use the information gained from assessments to adapt their instruction to individual needs. In any event, regular assessments can help both digital programs and teachers to provide tailored instruction that helps children learn within their zone of proximal development.

Personalizing to account for dynamic characteristics

Not all learner characteristics are helpful for the purpose of personalization. The notion that learners have preferred learning styles that enable them to learn more effectively, for example, is not supported by evidence. [Students don't learn](#) any better when the mode of presentation or organization of learning materials is in keeping with their preferences.

Successful personalization takes into account the fact that learners change during the learning process, and through interaction with that process. Personalizing to account for “static” characteristics, such as learning styles, appears to be much less effective than adapting to dynamic characteristics that change over time, such as knowledge or interest.

Existing knowledge can be inferred from the learner's performance on educational technology, or assessed separately and entered into the educational technology program. Motivational characteristics such as interest are usually measured through learner self-reports and then entered into the program. Ideally, dynamic personalization should measure these relevant factors and adjust instruction to reflect the most recent measurements as well as the underlying trajectories for each learner.

Considerable research remains to be done on personalization. Little is known about how learner characteristics interact to determine the effectiveness of instruction. For example, how does learning differ for someone who has considerable subject knowledge but low motivation, relative to someone with little knowledge but high motivation? And how should instruction take account of those variables? Because learners differ in multiple dimensions, truly personalized instruction requires considering a variety of learner characteristics simultaneously.

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The promising world of children's digital books

Digital books particularly benefit disadvantaged children



The screen time debate has left many parents and teachers wondering whether children should use screens for reading. Are print books better for children than digital books? Arguing that one is preferable to the other merely shifts the focus away from what really matters: why, how and what children read.

Why digital books?

Digital books come with several advantages, including the capability to store thousands of stories on a single device or to access them online, so children have lots of options when they're away from home or school. [Families living even far apart can read together](#) by screen sharing across devices, and they can follow along as a reader traces their progress on the digital page. Digital books can be bought individually, but there are also growing online libraries of free stories, many of which are [in underserved languages](#). With story-making apps like [Our Story](#) or [Book Creator](#), children can easily make their own books, becoming story authors from an early age.

Interactive features and content

When children engage in digital reading, the process is more interactive and multisensorial than when adults use their smartphones to read the news. Interactive digital books and apps may include highlighted words and sentences, voiceovers by authors or family members, and [touch-](#)

[based options](#), such as zooming in to the text or enlarging the story characters. In an effort to further our understanding of how the digitization of stories affects children's sensory engagement, I am currently working on a project to stimulate children's sense of [smell](#) as they read digital books.

Digital books that are equipped with too many enhancements and interactive features can [overwhelm children and interfere with their comprehension](#) of the story. However, features that help children advance through the story by touching characters to make them speak, for example, support reading comprehension. Designers therefore need to be careful to select the right number of enhancing features to include in children's books, and to make sure that those features truly support rather than hinder children's learning. As their reading skills advance, children start to interact with other features, such as the font size and the layout of the text in columns and on pages.

Does it matter whether a child reads a fantasy story about walking on the moon or an ABC book of science facts? The genre plays a role in children's learning. When it comes to digital books, children tend to [learn more words from nonfiction](#) than fiction. But the child's age makes a difference, too. In one study, five-year-olds [learnt more](#) information from expository stories that aimed to inform than from fantastical stories, while three-year-olds absorbed the same amount of information from both types of story.

Supporting disadvantaged and vulnerable children

When children read a print book with an adult, they benefit from [a rich learning context](#). Although digital books cannot replace that shared experience, a well-designed digital book is a good alternative if no adult is available to read with the child. Digital books can support children's reading by providing 'contingent' feedback based on children's touch, their answers to questions, or their progress in the story. One study found that children were better able to [recall the story](#) when they read digital books with contingent feedback than when they read digital books lacking features that responded to their engagement. The contingent features seem to be especially useful for children who struggle to concentrate during reading.

Digital books are a favourite learning resource for many children with special reading needs, as features can be customised to each individual. [One of our projects](#) showed that children with complex learning needs, as well as their caregivers, highly valued the option of creating their own digital stories. Digital books can help children who have difficulty with language to [learn new words](#) and improve the [literacy of children with poor letter knowledge](#).

Digital books appear to benefit disadvantaged children the most. Children from low socio-economic backgrounds acquire more literacy skills from digital books [than do children from middle socio-economic backgrounds](#). Furthermore, digital books are [an important learning tool](#) for displaced families and families that are on the move. The [digital libraries that have been created for Ukrainian refugee children](#) exemplify how digital books can provide access to stories when print books are not an alternative. Online libraries not only offer vulnerable groups mobile and scalable access to stories; they also enable these groups [to translate, audio-record and create their own stories](#) in times of crisis.

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Explore more on **BOLD**

BOLD has a [hub dedicated to technology](#) where you can find more articles, interviews, and podcast episodes covering research, opinions and issues on this topic. If you're keen to explore more after reading this collection, we recommend starting with these.



How technology can encourage collaborative learning

An episode of Teachers' Voices podcast.

[Listen to the episode >](#)



Ensuring EdTech is truly educational

How can we unlock the potential of EdTech?

[Read the article >](#)



Helping every child maximize their potential through personalized education

Is personalized education a human right?

[Read the article >](#)



How can children exercise their agency?

Participating in technology design gives children choice and control.

[Read the article >](#)

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Part 2

Explore technology with kids

Three relevant *Frontiers for Young Minds* articles that you can use to explore issues around educational technology with your class or other young learners

Activities from the *Frontiers for Young Minds* team to try with your class to help them consolidate the ideas explored in the articles

Articles for kids

Frontiers for Young Minds have published articles about educational technology, written by top researchers and peer-reviewed by kids aged 8-15 to be engaging and accessible. These are an excellent basis for class reading and discussion, as well as general interest reading for young people at home.



Mind Games: Technology and the Developing Teenage Brain

How does your brain work, develop as you grow up, and interact with different technologies? Understand how tech can help kids learn but also cause negative habits, so you're empowered to make good decisions about how to spend time online.

[Read the article >](#)



How Do Kids and Grown-Ups Get Distracted in Everyday Situations?

As you grow older, your attention span develops – but adults get distracted easily too! By studying distractions that involve multiple senses, like the TV, we can better understand how attention works, and use this knowledge to improve our attention habits around technology.

[Read the article >](#)



Think Before You Type on Instagram!

Social media is used by billions of people and one topic or hashtag can have millions of interactions. It's important to understand how our brains process social media. When we actively engage with it, such as commenting on a post, it is more likely to stick in our memory, so we need to choose wisely what we interact with to keep ourselves healthy.

[Read the article >](#)

Get the latest science for kids with your class by following FYM on [Twitter](#), [Facebook](#), and [Instagram](#), and for more great stories from science, read the [FYM blog!](#)

Class activities

After your class has read these FYM articles, explore educational technology with them using these activities. Find answers to the questions at the end.



Discussion

Challenge your class to a discussion using these questions:

- What high- and low-quality online activities can you think of? How can you avoid getting hooked on technology?
- What three factors influence attention and distraction? When you get distracted, what is likely to happen to the task you're trying to complete? Can you give me examples of times you've been distracted?
- What improves our memory of a social media post? What memories do you have from your social media and why are they so memorable? Why is it important to understand how our brains process and remember social media?



Play

Allow your students to access their phones (for a limited time!) or in a pair if anyone doesn't have theirs. Challenge them to:

- Find one post with lots of interactions and comments, which they also commented on.
- Remember why they commented on it, and how memorable it was for them.

- Make a list of the sort of posts they want to remember, and the sort they do not want to remember when going on social media, and share these with the class.
- At the end ask if anyone got distracted while looking. Explain there is no guilt needed, it's interesting! Ask what distracted them and why – was it video, audio, pictures, or specific themes? Share the post with everyone to see distraction in action!



Group work

Put the class into breakout groups and give them a set time to read and discuss the following situation.

“Robyn is 13 years old and has a brilliant new smartphone. At first, Robyn uses it to chat on social media with friends, share pictures from the holidays, look up information for homework, and watch YouTube videos to learn new skateboarding tricks. But Robyn checks her phone more and more often, she keeps it in her bedroom at night, and she worries when her photos don't get likes. Finally, Robyn ends up in a flame war with someone who made a mean comment on one of her posts, and she can't sleep because it makes her anxious.”

The groups should discuss the following questions.

- What is happening to Robyn's behaviour? How is her brain activity shaping her response to online interactions?
- Why is she seeking more and more online interaction, and why is this becoming negative for her?
- How can Robyn take back control, reduce her low-quality online activities and feel more positive again?



Creative writing

Ask your class to each write a response to one of these scenarios:

- Write a short blog post about distractions and whether adults *really* are more focused than kids. Make it simple and fun to read for readers your age. This can be a summary of your learning from the Distractions article.
- If you were to become a social media influencer, what sort of content would you create to encourage people to interact with it and remember it? Write three social media posts on a theme of your choosing to gain new followers. Think about what you want people to remember and the comments you would expect.

Answers

Discussion

High/low quality online activities

- High-quality activities require active engagement in a limited time, e.g. chatting with family and friends; working on a project; creating content; learning from videos.
- Low-quality activities cause feelings of envy, depression or loneliness, e.g. scrolling passively; comparing yourself to others on social media; using your device late at night when you need to rest or when you need to finish other tasks.
- Avoid getting hooked by turning devices off when doing homework; turning off the auto-play settings on videos to avoid watching beyond what you intended; turn WiFi off when doing important tasks; take breaks to see friends or for exercise and sports; make a weekend and after school schedule to help you manage your time; make a technology-use contract with your family.

Distraction

- The three factors that influence attention and distraction are 1) Task difficulty: a paragraph of short sentences is easy, a page of complex text is hard; 2) Type of distraction: auditory, visual, or audio-visual; 3) Age: as you get older, your ability to pay attention increases.
- When you get distracted, your task can still be completed but not as accurately or as fast.

Social media memory

- Writing a comment increases memory of a post – the longer the comment, the more likely you are to remember the details.
- It is important to understand how our brains process and remember social media because unless we control our use, we might remember harmful or frightening things which affect our mental health.

Group work

- Robyn has gone from high- to low-quality online activities. She cannot yet fully master her cognitive-control centre to make decisions and learn from experiences.
- Robyn is getting hooked on her online interactions. As a teenager, her socio-emotional development goals and extrinsic reward needs are outweighing her good decision-making processes, and she is spiralling into behaviours which make her depressed, anxious or envious.
- Robyn can make herself a schedule to avoid spending too much time on her phone; leave her phone outside her bedroom at night; make time for other activities such as meet-ups with friends or social clubs after school.



Creative writing

Blog post about distractions

- Our ability to pay attention improves with age. But adults get distracted, too.
- Adults are actually worse at ignoring distractions involving both shapes and sounds than 6-year-olds are.
- By being aware of distractions, particularly those that involve multiple senses (audio-visual), we understand how our attention works in everyday situations and can pull ourselves back from distractions.

Social media posts for memorability

- With comments, themes are nearly equally memorable, but without comments, the top themes are dogs and unhealthy foods.
- Use images, as people respond more to posts with images.
- Encourage people to comment within the post – for example, “Send me your dog photos!”
- Encourage longer comments or use memorable hashtags to engage readers more – for example, “What’s been your favourite bad food moment? #GuiltyPleasures”.

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