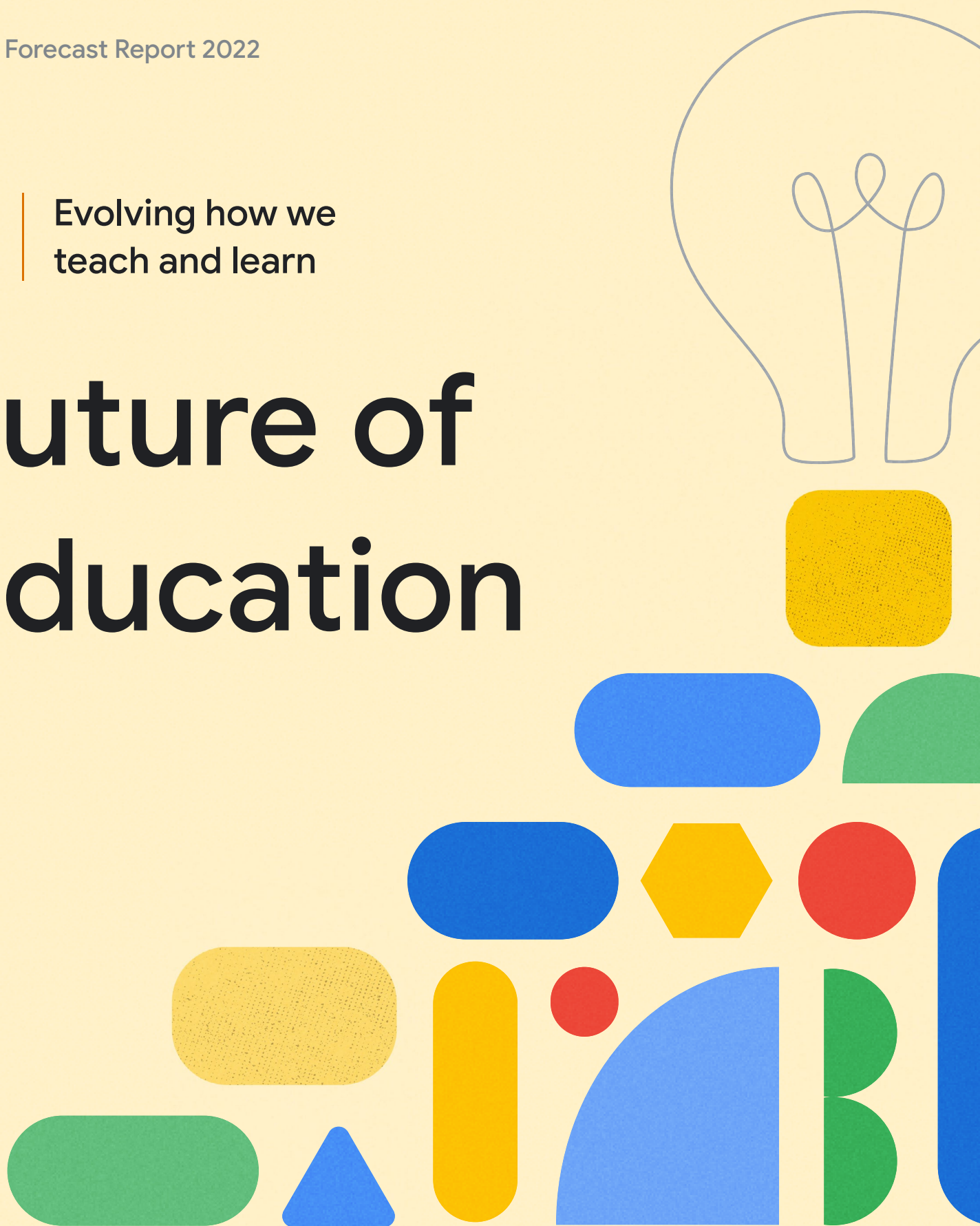


## 2 | Evolving how we teach and learn

# Future of Education



# Table of contents

Foreword	<u>02</u>
Executive summary	<u>03</u>
<b>Trend 1:</b>	
<b>Making learning personal</b>	<u>05</u>
Advancements in artificial intelligence (AI) and adaptive technologies enable educators to meet learners where they are, with experiences tailored to their needs.	
<b>Trend 2:</b>	
<b>Reimagining learning design</b>	<u>23</u>
As new technologies become more accessible, educators aim to understand how they can support engaging and enriching learning experiences.	
<b>Trend 3:</b>	
<b>Elevating the teacher</b>	<u>38</u>
As the educational landscape changes, teachers shift from being 'gatekeepers of knowledge' to 'choreographers of learning.'	
Glossary	<u>56</u>
Our research approach	<u>57</u>
Related reports	<u>61</u>
About Google for Education	<u>62</u>

# Foreword

At Google, we believe that, no matter your background, everyone deserves access to great learning experiences.

The opportunity to learn in the classroom, at home, and everywhere in between, has never been more important than it is today.

As the world evolves, driven in part by pressing global issues and the accelerated rate of technological innovation, what we learn and how we learn will evolve too. This will mean developing new mindsets and skill sets to become global problem solvers and lifelong learners; evolving how we teach and learn by making learning more personal and accessible to all; and finding more meaningful ways to evaluate learning tools and learner progress, to best support the goals of educators, students, and families.

As we march towards a radically different future, what should the role of education be and how might it look? To begin to answer this question, we collaborated with research partner Canvas8 to conduct a global study in 24 countries that synthesizes insights from 94 educational experts, two years of peer-reviewed academic literature, and a media narrative analysis across the education sector. Global nonprofit American Institutes for Research

served as an advisor and consultant to this research. The result is a three-part report on the future of education.

This is Part 2: Evolving how we teach and learn.

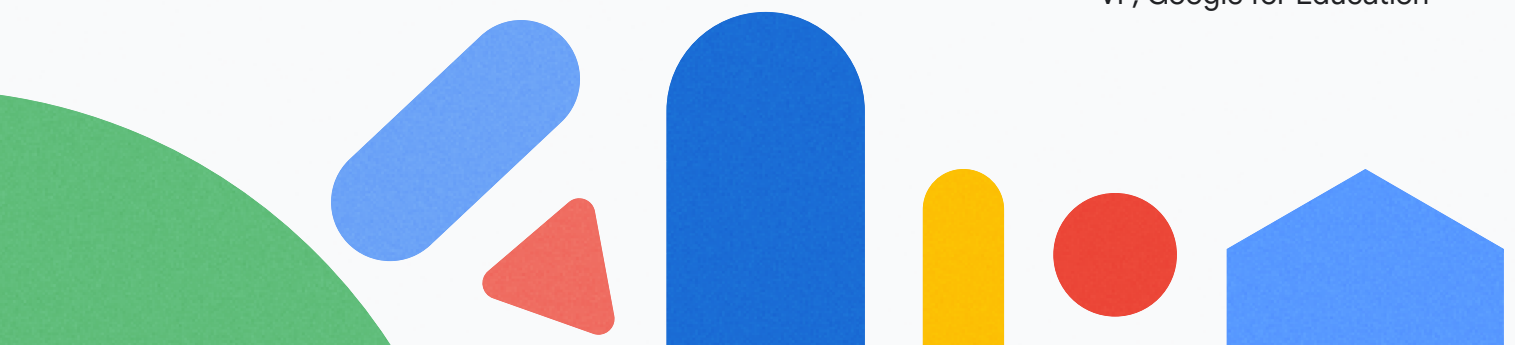
We acknowledge that, just as there is Maslow's hierarchy of needs for life, so too there exists a hierarchy of needs in education. Some educators and leaders have the luxury of building for the future, while others are forced to tackle more immediate challenges, such as student attendance or literacy. As such, the future of education will be shaped by a complex, nuanced process rather than a single wave of change. We also recognize that there is significant variation in perspectives on the role of education across and within different markets; our intention is not to present a comprehensive or uniform view of the future.

Instead, we hope that this research can help provide educators and education leaders with a common understanding of the trends informing the future of education, and spark ideas and discussion on how we can best work together to help all learners — and those who help them — succeed.

Thanks for coming with us on this journey,

**Shantanu Sinha**

VP, Google for Education



# Executive summary

In the last few years, the rate of change in education has accelerated faster than anyone previously thought possible. The educational experts we interviewed shared how recent technological advances are evolving how we think about teaching and learning, from a one-to-many model to a more personal approach; where the role of the teacher evolves, and the possibilities of new immersive technologies start to reframe the way we think about learning design.

*The views and opinions expressed in this report are those of the experts and do not necessarily reflect the views or positions of any entities, institutions or organizations they represent.*





In our research, we identified three key trends driving this shift

#### TREND 2

### Reimagining learning design

As new technologies become more accessible, educators aim to understand how they can support engaging and enriching learning experiences.



#### TREND 1

### Making learning personal

Advancements in artificial intelligence (AI) and adaptive technologies enable educators to meet learners where they are, with experiences tailored to their needs.



#### TREND 3

### Elevating the teacher

As the educational landscape changes, teachers shift from being 'gatekeepers of knowledge' to 'choreographers of learning.'

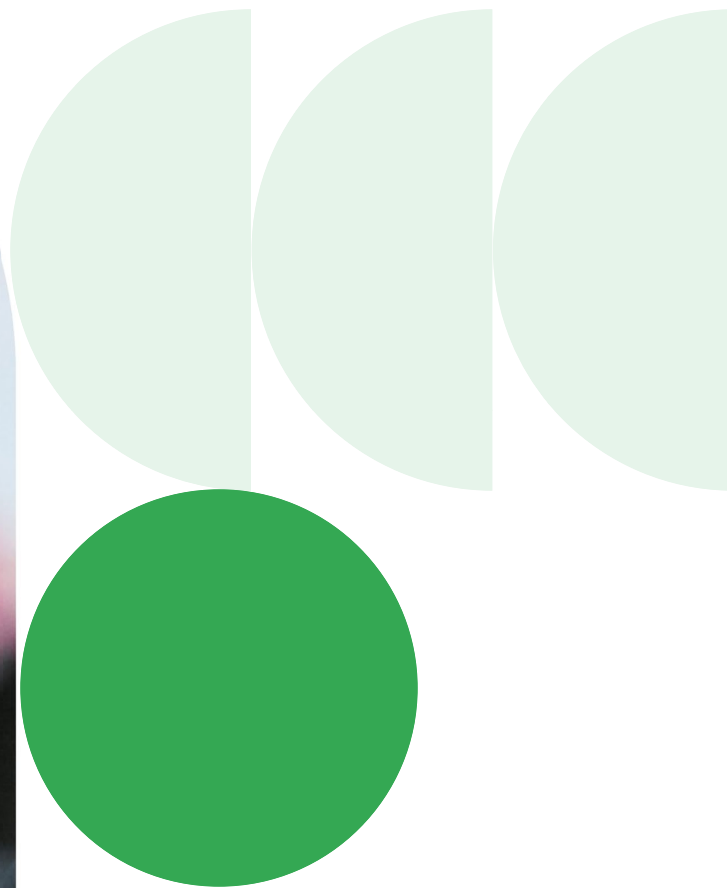
TREND

1

# Making learning personal



Advancements in artificial intelligence (AI) and adaptive technologies enable educators to meet learners where they are, with experiences tailored to their needs.





# How will educators use technology to address the individual needs of learners?

In the 2016 book, *The End of Average*, director of the Mind, Brain, and Education program at Harvard University, Todd Rose, argued that a major problem with schooling around the world is that it is designed around an “average learner” — a person that doesn’t exist. This point hits at a central concern that educators have wrestled with for decades: how do we make the process of learning more personal for each student?

Personalized learning experiences also have the potential to close equity gaps in education.

Personalization aims to increase student engagement and performance by creating responsive learning experiences that take into account each individual learner’s needs and interests.<sup>1</sup> By designing education that meets students where they are, personalized learning experiences also have the potential to close equity gaps in education. This means ensuring that all learners have the appropriate and targeted support and materials that they need to learn — regardless of their ability and background.





## Three ways to make education more personal

### 1 Differentiation

Instruction that is tailored to the learning preferences of different learners. Learning goals are the same for all students, but the method or approach of instruction varies according to the preferences of each student or what research has found works best for students like them.<sup>2</sup>

### 2 Individualization

Instruction that is paced to the learning needs of different learners. Learning goals are the same for all students, but students can progress through the material at different speeds according to their learning needs. For example, students might take longer to progress through a given topic, skip topics that cover information they already know, or repeat topics they need more help on.<sup>3</sup>

### 3 Personalization

Instruction that is paced to learning needs, tailored to learning preferences, and tailored to the specific interests of different learners. In an environment that is fully personalized, the learning objectives and content as well as the method and pace may all vary (personalization encompasses differentiation and individualization).<sup>4</sup>



While efforts to make education more personal have long been underway, advances in AI now make it possible to move at a speed and scale we've only imagined. Today, AI is capable of giving students 1:1, in-the-moment feedback on their work. As the technology becomes more sophisticated, virtual learning companions will become even more capable of actually delivering instruction and challenging students to think through problems.<sup>5</sup> AI-enabled support for students goes beyond designated learning platforms. Digital assistants have already become an informal homework helper to many

students.<sup>6</sup> To put this into perspective, in just a couple of years, it's predicted that there'll be around 640 million smart speakers installed globally, many inside homes.<sup>7</sup>

When we talk about making learning more personal, it's not just about providing students with targeted, in-the-moment support, but also about making educational content feel relevant to the individual learner. Studies show that when students better relate to what is taught in schools, it can have a positive impact on student engagement, enjoyment and performance.<sup>8</sup>

“ Education should be personal ... learning is a social process. The face-to-face learning space needs to be reinvented to enable the optimal use of time together, to collaborate in the fullest possible sense.

Valerie Hannon

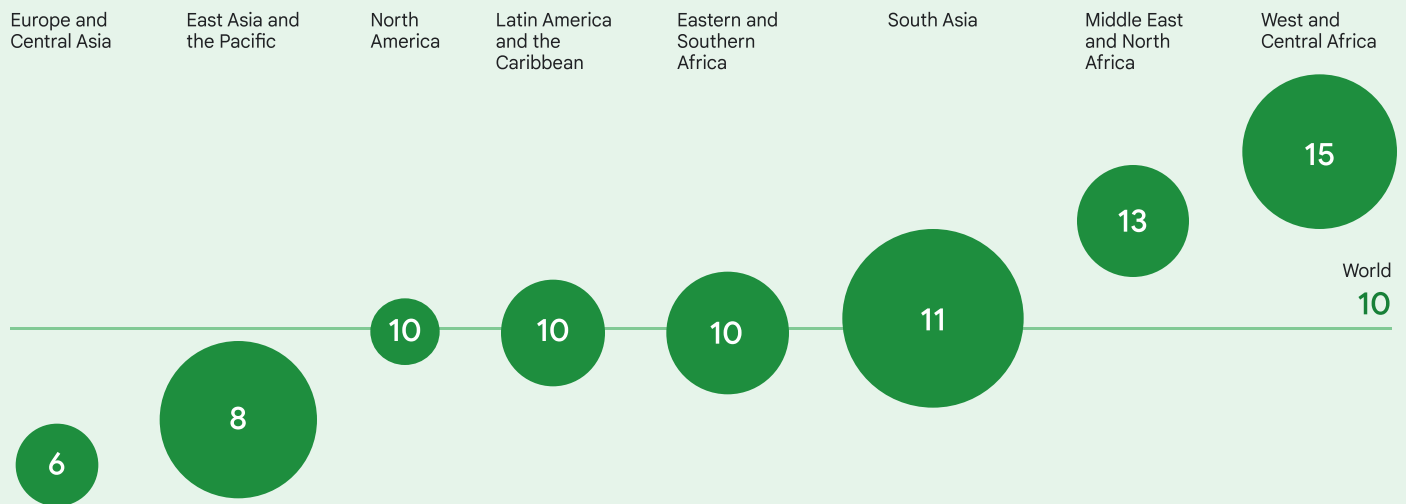
co-founder, Innovation Unit, United Kingdom

On the other hand, when learners don't see themselves reflected in the content or curriculum, their feelings of belonging at school — an important predictor of engagement — can drop.<sup>9</sup> This creates an opportunity to provide more adaptive and personalized materials that help better reflect, and inspire, all students, and drive a greater sense of inclusion — particularly in the context of the “troubling lack of diverse representation” of different groups within educational content.<sup>10</sup>

Ensuring that educational content and delivery is adaptable to the diverse needs of different learners is also a priority. For example, students with disabilities, such as cognitive, visual, hearing or physical impairments, have specific needs when it comes to learning. The development of new kinds of assistive technologies (AT) — tools which increase, maintain or improve learning for people with disabilities — will unlock new potential solutions to address those specific needs both inside and outside an educational setting.<sup>11</sup>



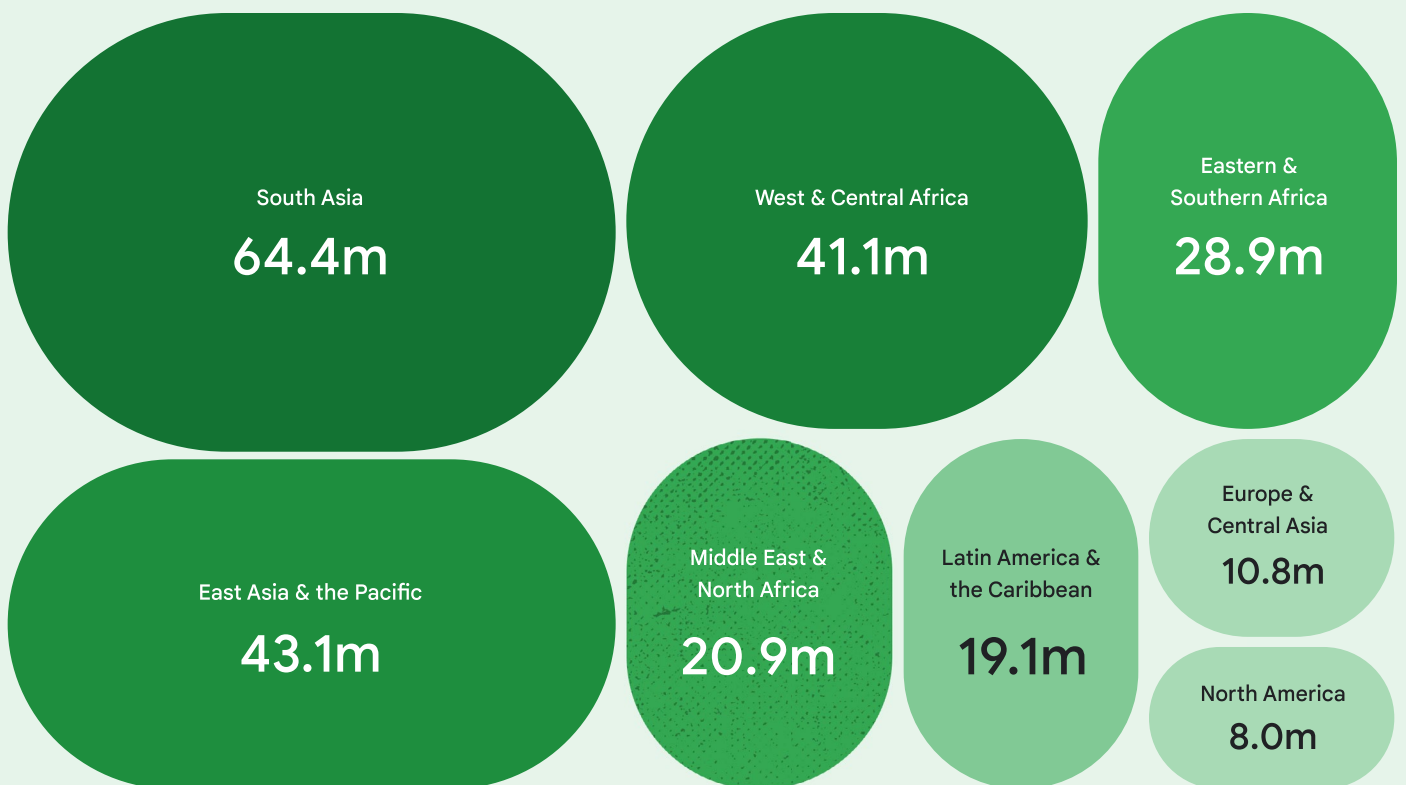
## Percentage of children aged 0 to 17 years with disabilities



Note: The size of the circles reflects the number of children with disabilities in the respective regions.

Source: UNICEF, "Seen, Counted, Included: Using data to shed light on the well-being of children with disabilities," 2022

## Number of children aged 0 to 17 years with disabilities



Notes: The global estimate is based on a subset of 103 countries covering 84 per cent of the global population of children aged 0 to 17 years. Regional estimates represent data covering at least 50 per cent of the regional population of children.

Source: UNICEF, "Seen, Counted, Included: Using data to shed light on the well-being of children with disabilities," 2022



## The spectrum of assistive technologies<sup>12</sup>

### Low-tech

Technology that is readily available, inexpensive, and typically does not require batteries or electricity. Some examples include graphic organizer worksheets and pencil grips.

### Mid-tech

This type of tech is usually digital and may require batteries or another power source. Examples of this type of assistive technology include talking calculators and digital recorders.

### High-tech

Devices that are typically computer-based, likely to have sophisticated features, and can be tailored to the specific needs of an individual student. Examples include voice-recognition software and tablets.



While education has traditionally been a one-size-fits-all approach, learning is personal. The promise of AI is in helping educators and leaders tailor instruction to the individual, providing students with in-the-moment feedback, extra support, and, ultimately, ensuring that all students — regardless of need or ability — feel seen and heard.

“

The biggest game changer would be to actually allow teachers and students to choose what kind of information, what kind of solutions, what kind of edtech they want to use, based on what motivates them. I think that could help generate renewed enthusiasm around education.

Thor Ellegaard

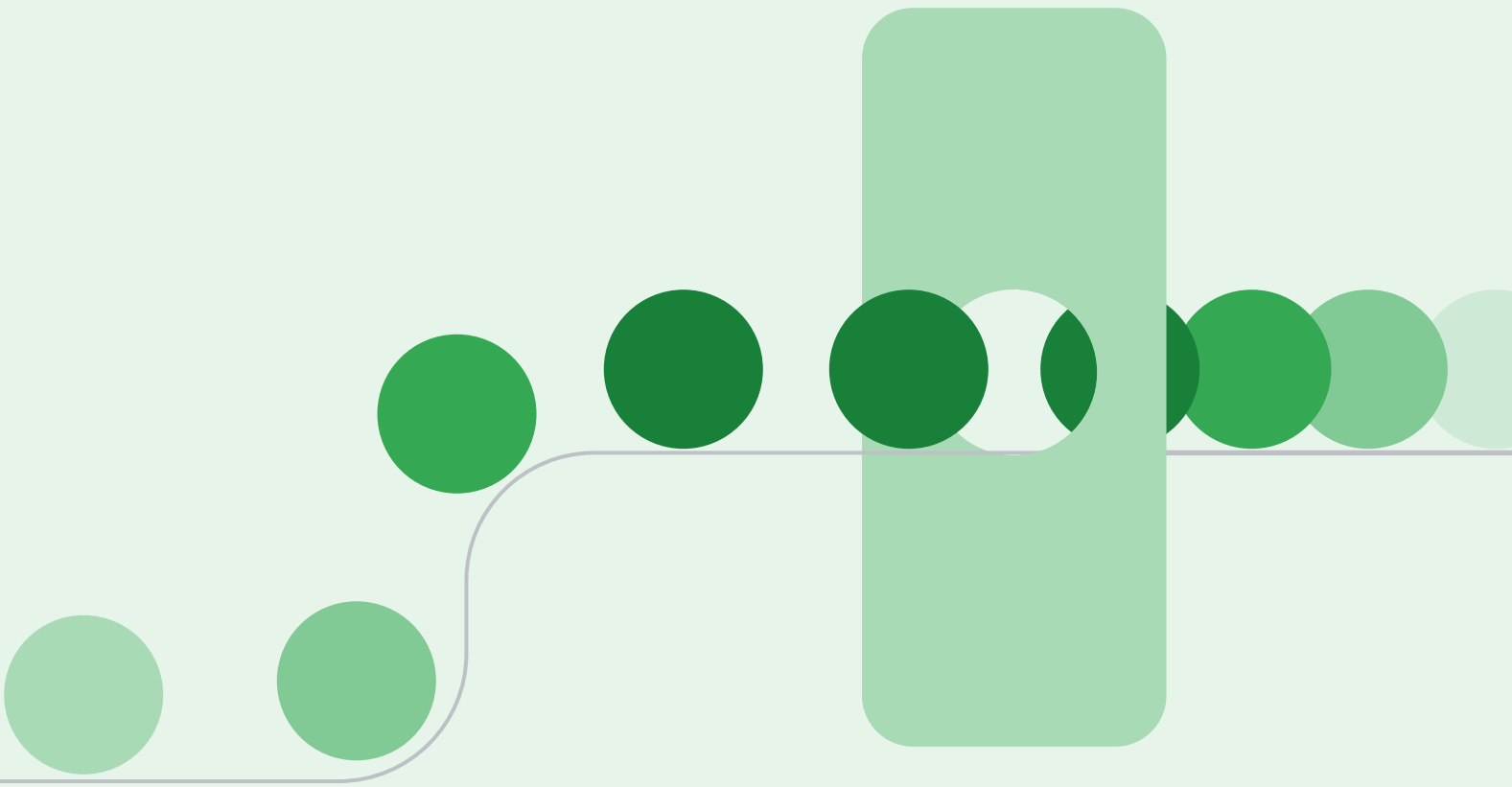
*hub director, EduHub and previous board member, Danish Learning Analytics Network, Denmark*



## Ideas in action | *United States*

# More targeted interventions

Educational platforms like Carnegie Learning use AI to help streamline homework and lesson planning for teachers, while also giving more in-depth insights into how a class, or an individual student, is doing. This enables teachers to provide targeted, in-class support to learners in the areas that need improvement. Carnegie Learning's digital learning coach, MATHiaU, leverages AI to adapt to student's learning needs at a detailed, skill-by-skill level, offering students customized, just-in-time feedback and contextual hints.<sup>13</sup>

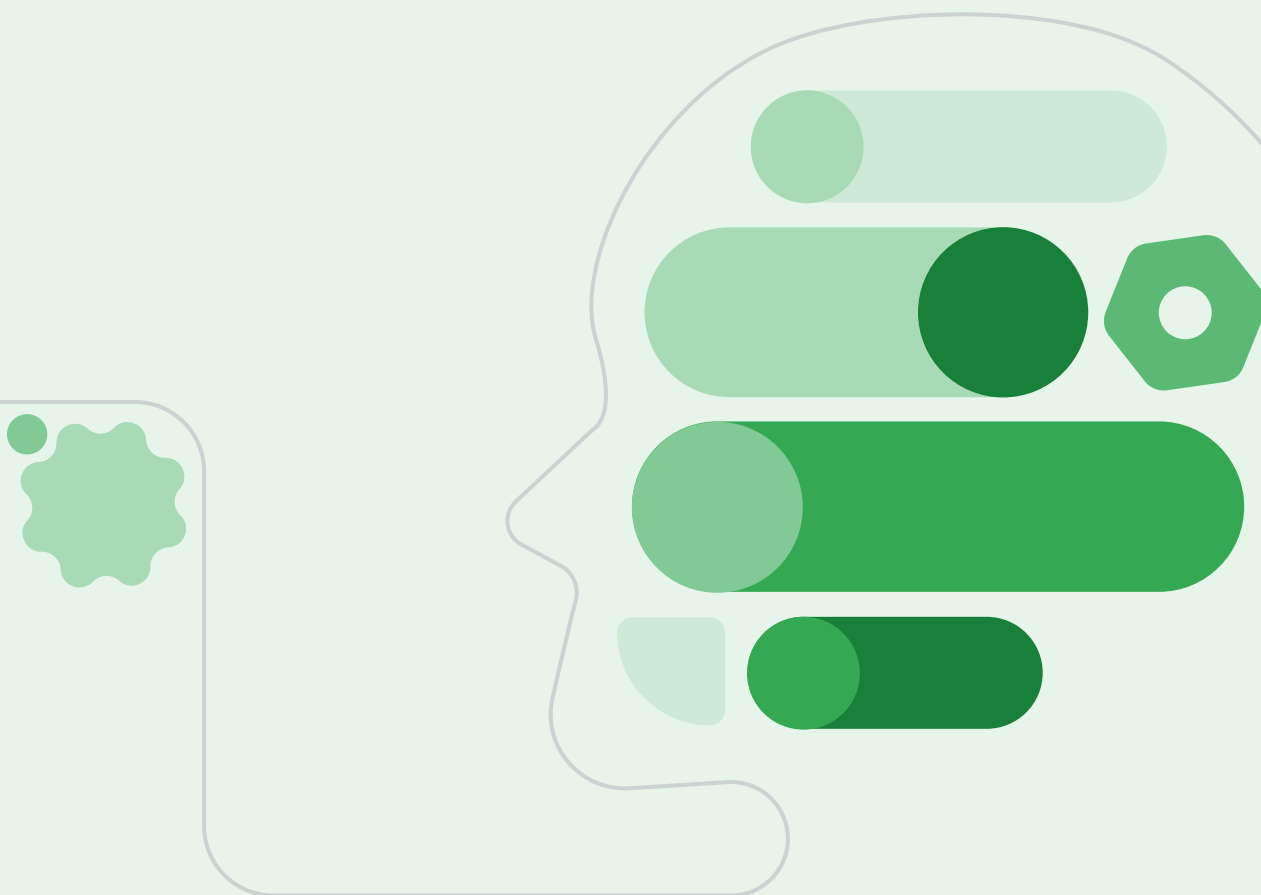




Ideas in action | *Israel, United States*

## Challenging stereotypes in educational materials

In a partnership between the Hebrew University of Jerusalem and technology company WolframAlpha, AI was used to generate a virtual Einstein that could answer a range of science questions.<sup>14</sup> Used effectively, this technology could be applied to better reflect different learner identities in digitally-delivered education materials (such as videos and online textbooks) to counter the lack of representation. For example, applied to STEM educational materials, it could be used to generate new characters that counter historical gender stereotypes.<sup>15</sup>



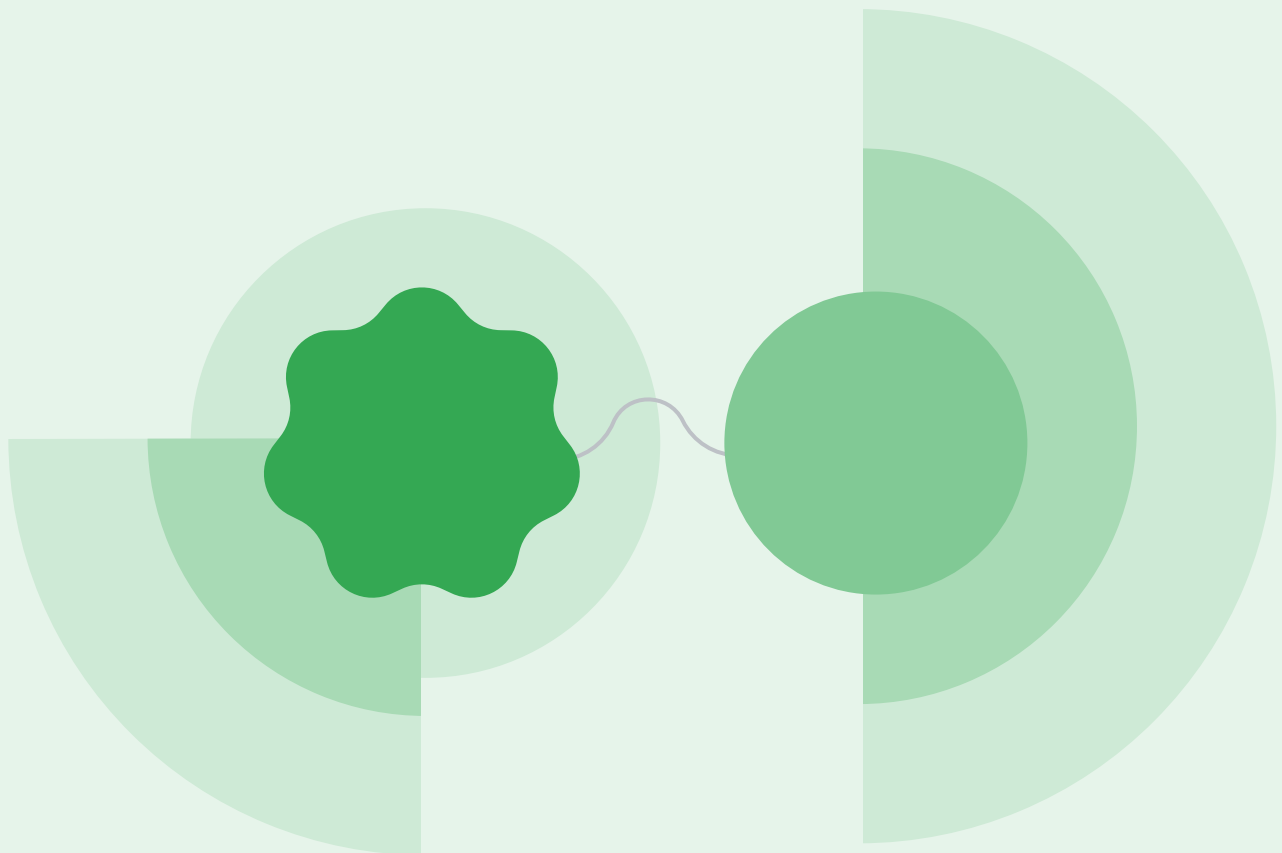




Ideas in action | *Netherlands*

## AI-enabled transformative assistive technologies

Developed on the Google Glass hardware, a Netherlands-based assistive technology company called Envision debuted a pair of smart glasses in 2020 which use AI to help people with visual impairments better interpret real-world scenes via speech output, including reading handwriting and recognizing friends and family.<sup>16</sup>





# The Google perspective

Making learning personal

At Google, we're optimistic about the potential for AI and other advanced technologies to empower people, benefit current and future generations, and serve the common good. In education, AI has the potential to make learning personal, by providing learners with 1:1 support and real-time feedback. For example, let's say you're a student stuck on a math problem. With 20+ other students in your class, you may not be able to get immediate support. This may leave you feeling frustrated or diminish your confidence. Now imagine a different scenario: you're a student stuck on a math problem and are able to get in-the-moment support via a hint or video that gives you exactly what you need to unblock you. You understand how to change your approach, complete the problem correctly and feel more confident in your ability to learn.



This is the concept behind practice sets in Google Classroom (in beta at the time of writing). With practice sets, students working on an assignment receive instant feedback on their answers, and real-time support through visual explainers and videos. When students get an answer correct, practice sets will celebrate their success with fun animations and confetti. One fifth grader called it “magic.” At Google, we call it the power of AI.

When we apply AI to education, we are able to personalize content to a student’s learning path, meeting them where they are in their studies and their schedules. This is one of the functions of Google Cloud’s learning platform and interactive tutor. Education institutions are able to incorporate a cloud-based interactive tutor, which assists with generating learning content to help learners master core concepts. For example, the interactive tutor can generate targeted questions based on reading materials to help students understand and practice concepts in a way that meets their individual learning needs.







Over the past 3 years

30m+

kids have read

120m+

stories on Read Along.

Among its many use cases, AI can also be used to improve global literacy. This is the principle behind Read Along, an app that helps kids learn to read independently with the help of a reading assistant, Diya. Over the past three years, more than 30 million kids have read more than 120 million stories on Read Along. The app uses Google's advanced text-to-speech and voice-recognition technologies to give young readers personalized support. When the app was piloted in 200 villages in India, 64% of pilot participants with access to the app showed an improvement

in reading proficiency, and 95% of parents from the pilot study said they would let their children continue to use the app if left on their phones.

Tools like Google Lens use AI to help learners of all ages make sense of the world around them, from identifying plants and animals to translating text from more than 100+ languages. Students can snap a picture of a problem to quickly find explainers, videos, and results from the web for math, history, chemistry, biology, physics, and more.



Another part of making learning personal is ensuring that all students have the tools they need to express themselves and access information in a way that works best for them. That's why we've built accessibility features directly into our education tools. For example, for people using screen readers and refreshable braille displays, we've enabled comments and highlights in braille, so that students reading a Google Doc can hear start and end indications for comments and highlights alongside the rest of the text. Also for people using screen readers, we've enabled alt-text in Gmail, which allows people to add content for an image. To help students who have trouble writing — whether that's because of dysgraphia, having a motor disability or something else — students can speak into any text field on their Chromebook simply by clicking on the mic icon in the status area or pressing Search + d to dictate. We see how useful these features are when we see them in action. We spoke with one professional who works with students with hearing loss who attend local schools. She and her students use the accessibility features in Google Classroom. For example, they integrate YouTube videos with automatic captioning and rely on captions in Google Meet. In fact, their efforts to improve access to information during school assemblies kicked off a school-wide, student-led accessibility initiative to raise awareness about hearing loss and related accessibility issues.

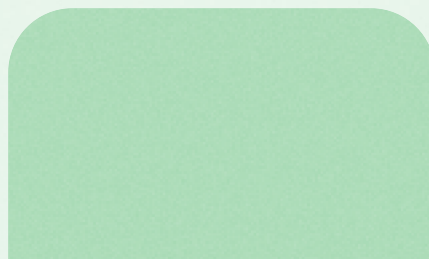
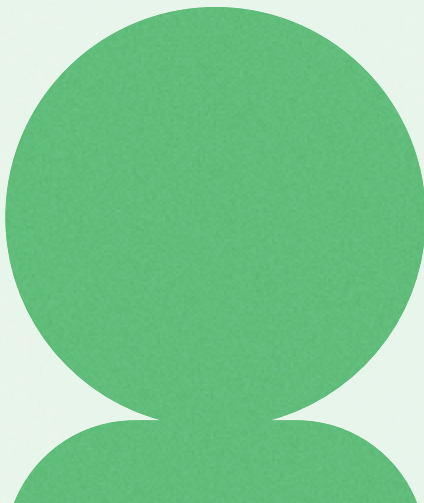
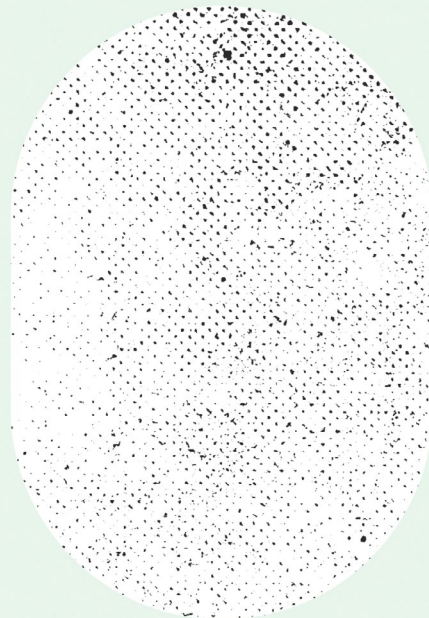
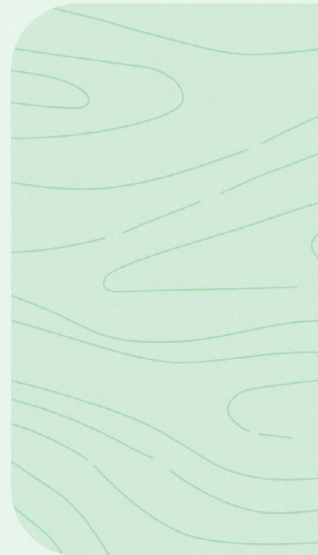
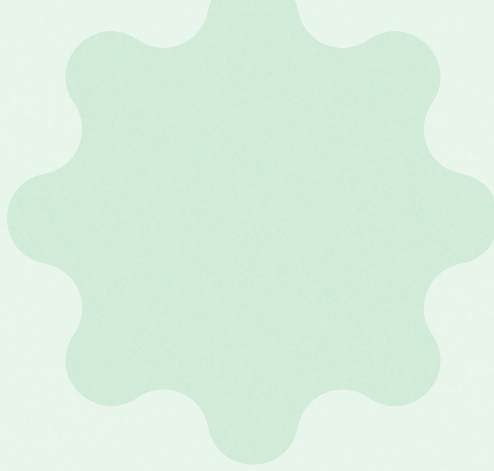
Another part of making learning personal is ensuring that all students have the tools they need to express themselves.



By applying AI to student learning experiences, and ensuring that our tools are accessible to all different types of learners, we can help support students where they are and help them get to where they want to go faster. And we're just scratching the surface of what is possible.



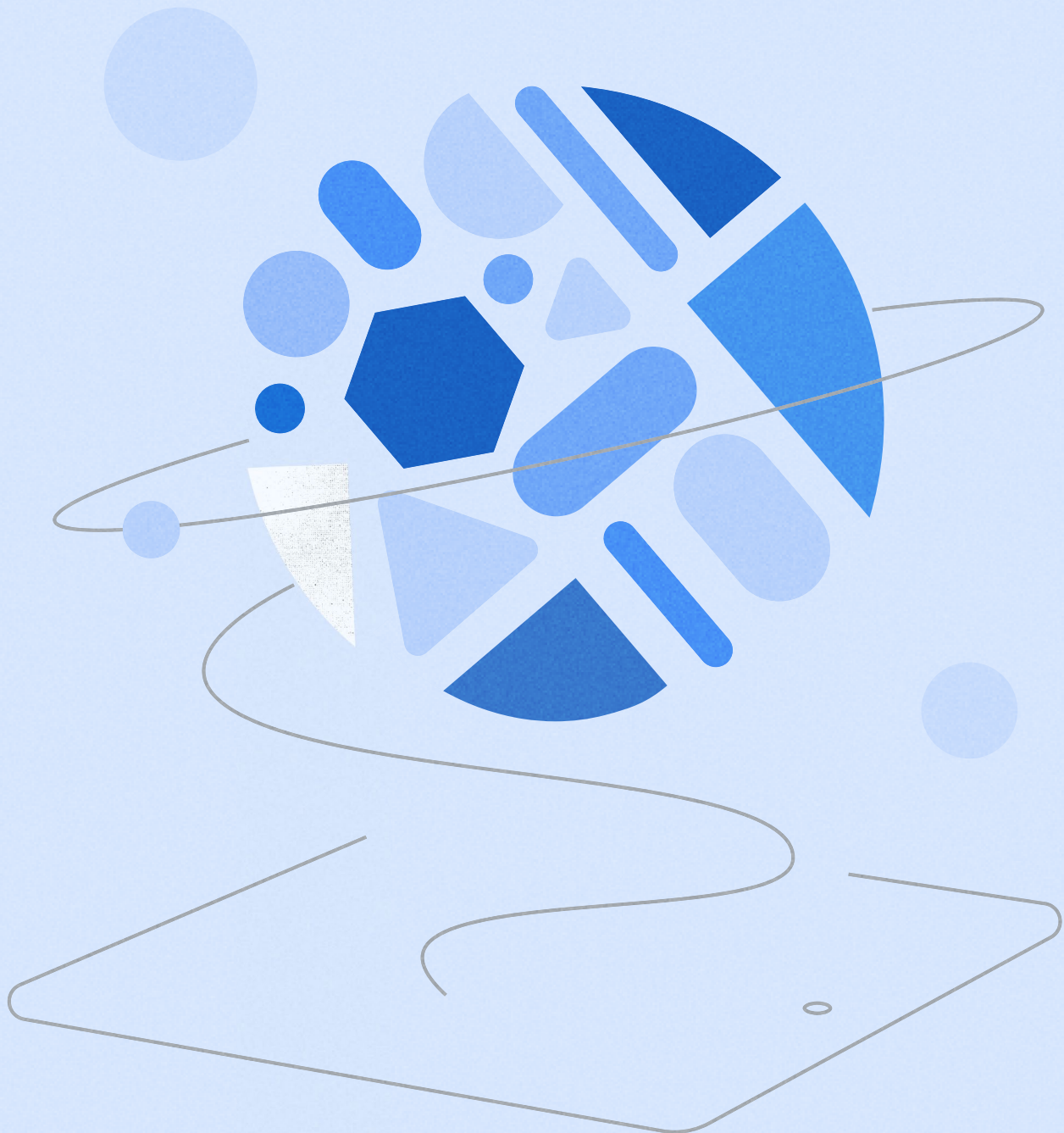




TREND

2

# Reimagining learning design





As new technologies become more accessible, educators aim to understand how they can support engaging and enriching learning experiences.



# How can learning design be enhanced by new technologies?

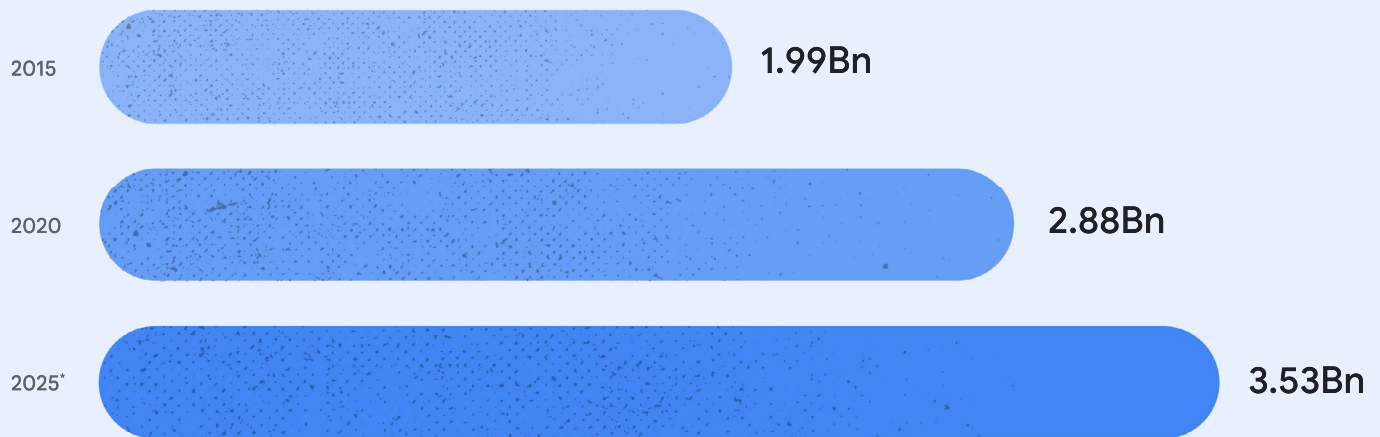
The last decade has seen a remarkable pace of technological innovation, as possibilities that were once the realm of science fiction — like virtual reality (VR) headsets, the metaverse, and augmented reality (AR) — have become an increasingly common part of everyday life.<sup>17</sup> Given their growing prevalence, particularly among young people, and with advocates describing AR and VR as ‘breakthrough technologies’ that could become ‘the learning aids of the 21st century,’ educators are keen to understand how these tools can also work inside the classroom.<sup>18,19</sup>

This excitement is tempered with pragmatism. The experts we spoke to consistently made the point that the focus of these technologies should be on their unique ability to help teachers fulfill an unmet student need, or unlock new learning experiences that would otherwise be impractical or impossible.



## Gaming growth

2015-2025\* Global Players

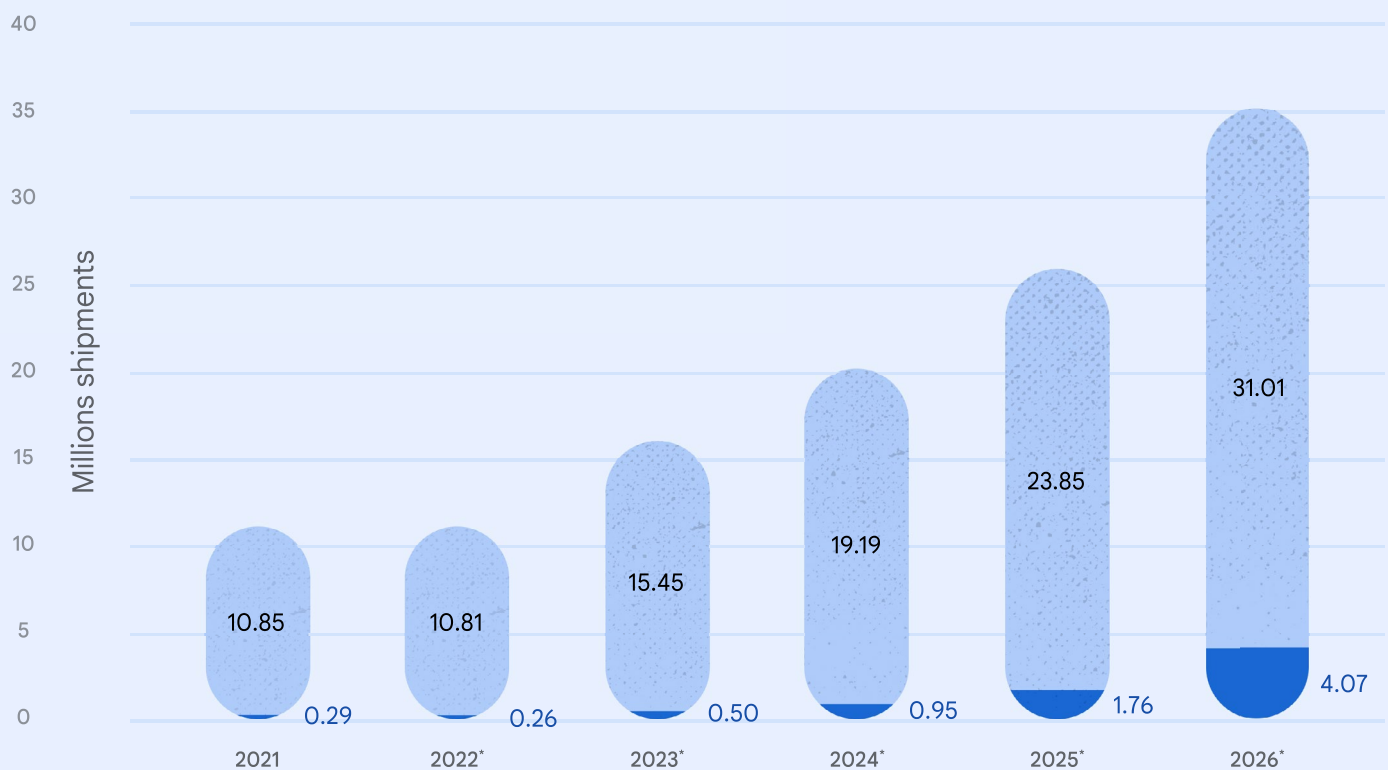


\*Forecast

Source: Newzoo, "Global Games Market Report," 2020; Newzoo, "Global Games Market Report," 2022

## AR/VR headset shipments worldwide

2021-2026\*



\*Forecast

Source: IDC, "Worldwide Quarterly Augmented and Virtual Reality Headset Tracker," 2022

AR VR

“ With these technologies, students are becoming teachers ... we’re creating a generation of curious minds who’re able to develop this autodidactic way of thinking.

**Philippe Longchamps**

*recipient of the Teacher of the Year award in Sweden 2020 and  
Finalist for the Varkey Foundation’s Global Teacher Prize 2021, Sweden*

For visual and immersive technologies, one area of potential is experiential learning. Experiential learning, or ‘learning by doing,’ is a well established instructional method that aims to deepen learning by making it more hands-on.<sup>20</sup> Yet for teachers, this kind of learning can be complex, expensive, or impractical. The use of technology can make these types of learning experiences possible. For example, with augmented reality, educators can create a simulated science lab that allows students to step inside a nuclear reactor to understand the process of nuclear fission — and enable other experiences that would not be possible in real life.<sup>21</sup>





Gaming technology is another area inspiring new types of learning design. In 2022, there are 3.2 billion active video gamers globally, with one billion new players in the past decade alone.<sup>22</sup> Game-based learning, or learning which borrows characteristics from gaming, has been particularly successful because of its emphasis on active, self-guided learning.<sup>23</sup>

Games can enable people to explore and fail without consequence, and motivate people to try again.

For example, games can enable people to explore and fail without consequence, and motivate people to try again.<sup>24</sup> Applying this to learning has been shown to encourage a growth mindset.<sup>25</sup> In addition, educationally-attuned games offer a unique “sandbox environment” to develop in-demand skills, such as collaboration, teamwork, and complex problem-solving.<sup>26</sup> For example, a research study which used a game focused on teaching empathy, called ‘Crystals of Kaydor,’ showed how games can help students learn skills like perspective taking.<sup>27</sup>



## Game-based learning vs. Gamification

### Game-based learning

A type of active learning experience within a game framework which has specific learning objectives and measurable outcomes.

### Gamification

The process of applying game elements or mechanics to existing learning activities in order to promote enjoyment or engagement.

More simply, games can help make learning more fun and engaging — a principle that's driven the success of Kahoot!, a common fixture in modern classrooms, with over 2.5 billion students across 100 countries having used the platform. Studies into Kahoot! have shown how, when applied to learning, the platform can increase student engagement and motivation.<sup>28</sup>

Some see game-based learning as a way to encourage and support learning beyond the classroom through smartphone devices. In one study, simple smartphone games have shown promising results for teaching literacy to refugee children, who do not have access to effective instruction due to factors such as displacement and language barriers. For example, Feed the Monster is a smartphone game that introduces children to letters from the Arabic alphabet, combining audio and visual cues to prompt recognition of letters, syllables and words. It was found to improve basic Arabic literacy skills and the psychosocial wellbeing of children who played it.<sup>29</sup>

As we look towards the future of education, technologies like AR, VR and gaming can help teachers find creative ways to design fun and engaging learning experiences for students; however, these technologies must support a clear need and purpose, and be used as a supplement to the most effective tool of all: great teaching.



“

Rather than jumping on whatever technology trends come in, we have to always ask ‘how can they benefit children pedagogically?’ before we actually play with them. Decisions need to be made about how this is practically going to help children learn.

**Simon Lewis**  
*principal, Carlow Educate Together Primary School, Ireland*





Ideas in action | *Denmark, United States*

## New frontiers for ‘virtual field trips’

In Denmark, seventh and eighth graders traveled virtually to Greenland to investigate the consequences of climate change.<sup>30</sup> Students who participated showed significant increases across a range of positive outcomes, including the belief that their personal actions could make a difference and a desire to take action. Similarly, Deep Empathy, a UNICEF and MIT project, used deep learning technologies and VR to create synthetic war-torn images of Boston, London and other cities around the globe as a novel way to help increase empathy for conflict victims among young people.<sup>31</sup>



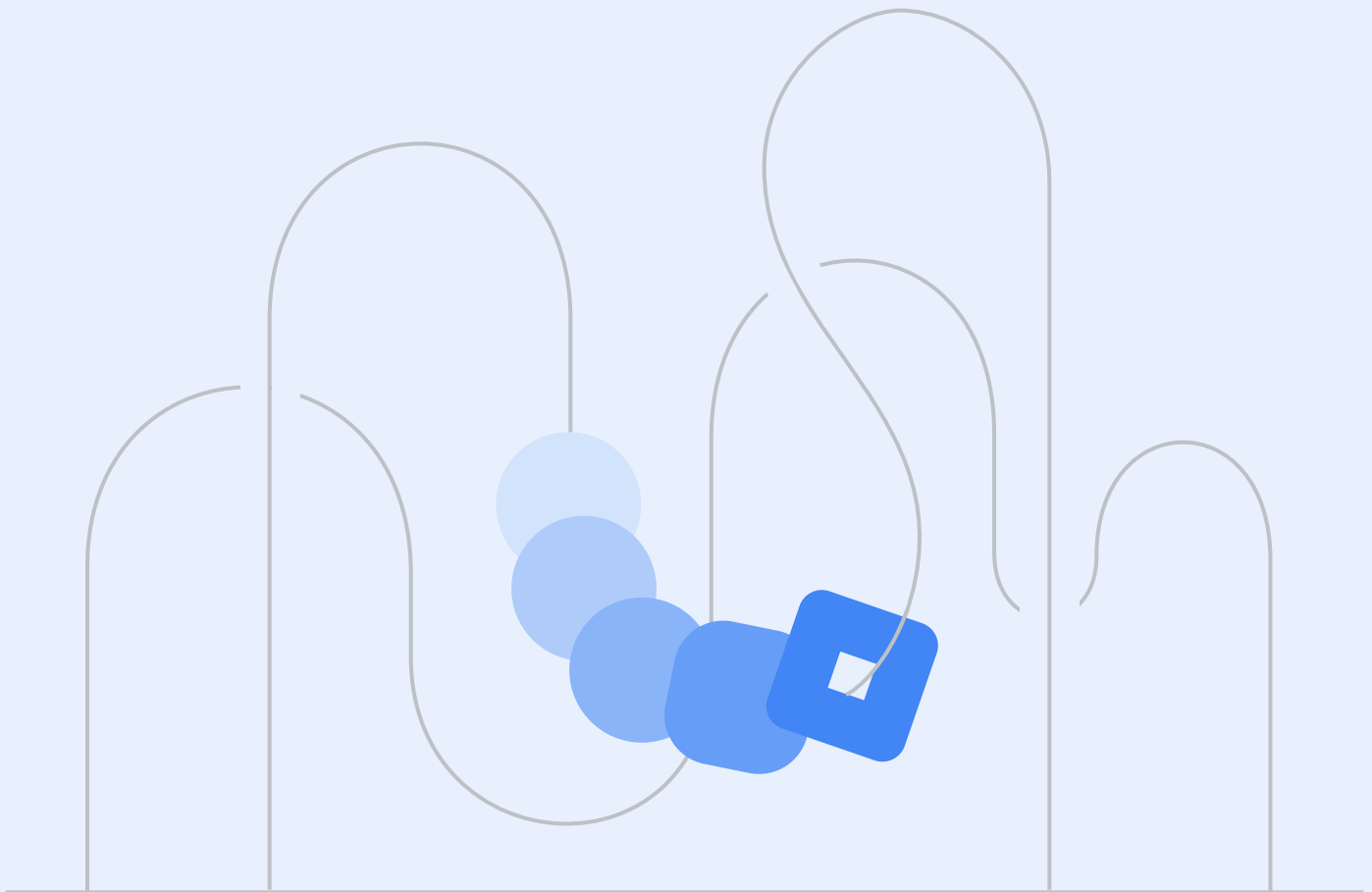




Ideas in action | *Global*

## Merging play with learning

With over 200 million active users, Roblox has become one of the world's most notable gaming platforms that's investing in educational applications.<sup>32</sup> Its Digital Civility curriculum, which piloted in 2020, involves 20 hours of instruction delivered through the game, aimed to help users combine learning about internet civility while improving STEM skills.<sup>33</sup>





Ideas in action | *United States*

## Platforms to support inquiry-based learning

E-learning company Desmos (over 75 million users) provides a free suite of math software tools (such as graphing calculators) for use in schools. The platform takes an ‘inquiry approach’ to learning, and helps use technologies to make abstract math problems more visual and concrete — changing the values on an equation, for example, would be visualized. Based in the cloud, it means students can learn as they go, and instantly see changes and feedback as they explore different math topics.<sup>34</sup>

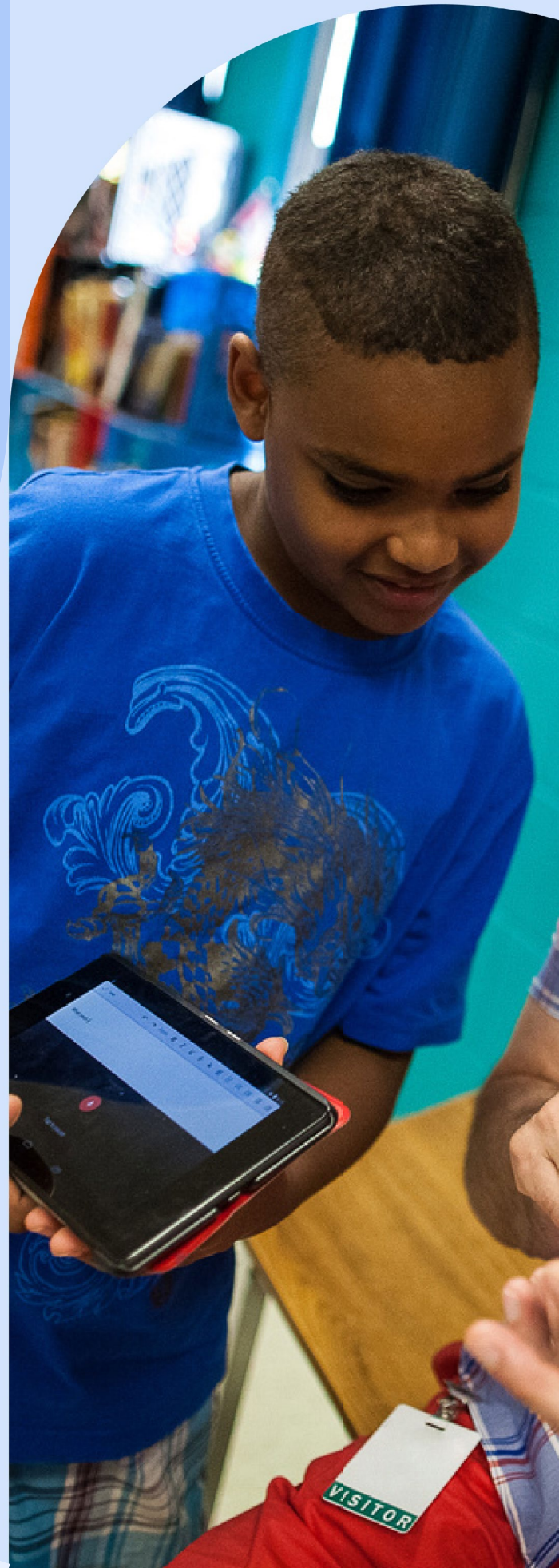




# The Google perspective

## Reimagining learning design

Emerging technologies have the potential to help teachers make learning more engaging and immersive. These tools can help enhance what students are taught in the classroom and provide access to learning experiences that would otherwise not be possible. At Google, we hope that by helping to make learning more immersive, we can make it feel more personal too.





For example, with AR, students and learners of all ages can explore the world, examine artifacts, gain new insight into and appreciation of historic and current events, and so much more. Want to study a dinosaur up close? With [Google Arts and Culture](#), learners can [project 3D models](#) into the real-world through a phone camera, from the big bang, to ancient animals, to priceless works of art. They can also take [global virtual field trips](#) covering science and technology, the arts, geography, and natural history, from touring the Palace of Versailles, to journeying to Mars, and more. With [Google Earth](#), exploring the world is a click away, from tracing Marco Polo's journey through Asia, to measuring how Alaska's glaciers have receded. These tools not only help make learning more

immersive, they also help individuals have greater agency over their learning journeys.

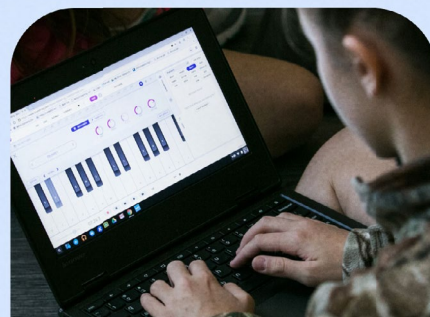
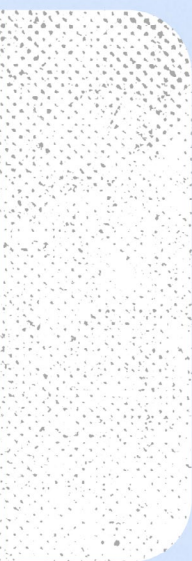
Another technology where we see enormous value is game-based, interactive learning tools, which have the potential to create fun and engaging learning experiences. It's one of the reasons we enabled [Google Classroom add-ons](#). With add-ons, educators and students can easily access an ecosystem of top edtech tools — from game-based lessons to interactive presentations and videos, and more — via a one-click login within Classroom. For example, educators can transform a traditional pop-quiz into a learning game, where students can test their knowledge and compete for points, while they cheer on their classmates.



While these technologies offer limitless potential to help expose students to new ideas and learning experiences, they will only be as strong as the teachers they support. Nothing makes learning more engaging than a great teacher. As we at Google work alongside teachers to help transform teaching and learning at scale, we see these technologies as another useful tool that school admins can enable, and teachers can use, to engage and inspire students to become active learners and informed global citizens.

As we look towards the future, we're excited about the potential for new technologies to help create fun, engaging, and memorable learning experiences, providing opportunities for learners both within and beyond the classroom.



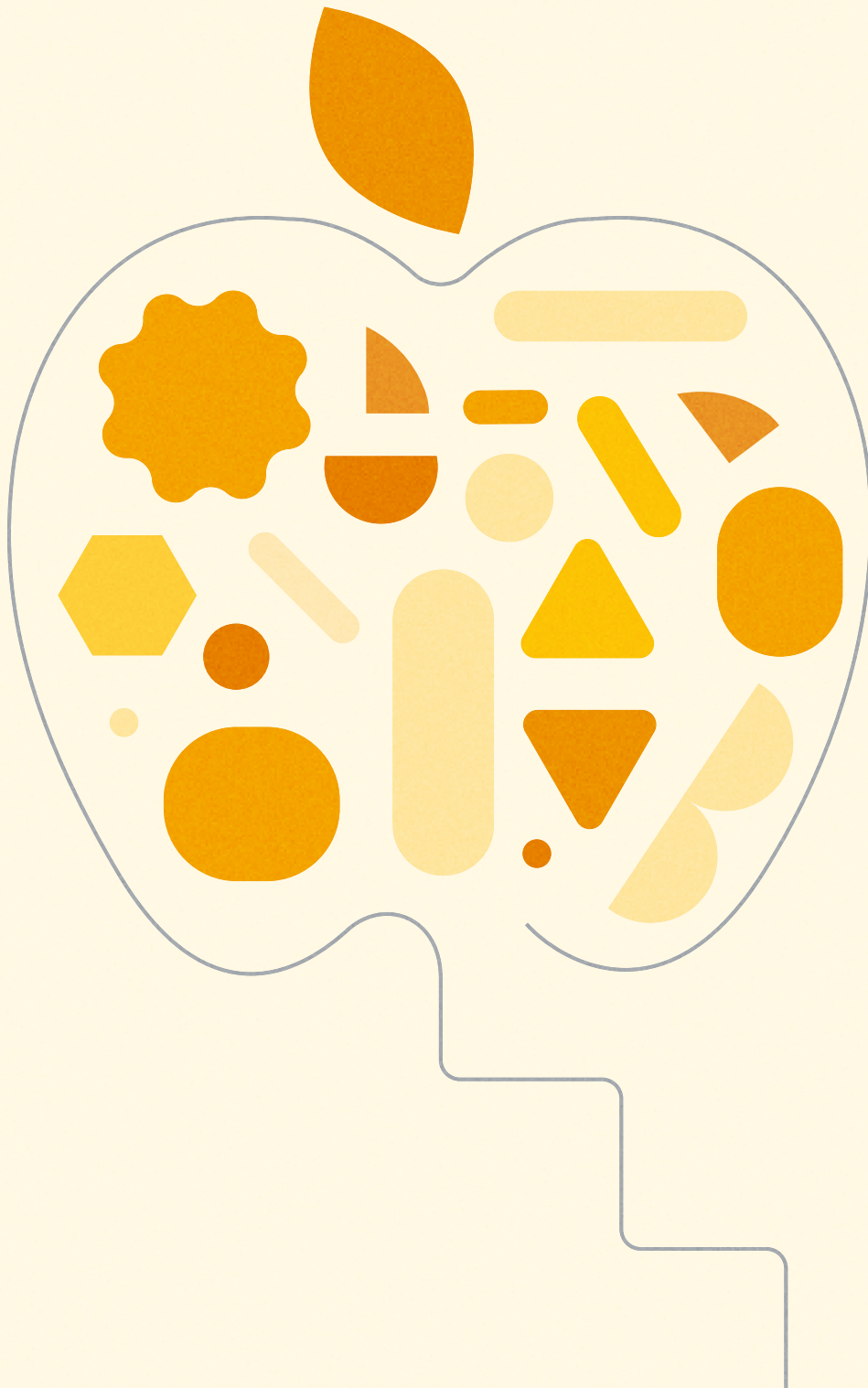




TREND

3

# Elevating the teacher



As the educational landscape changes, teachers shift from being ‘gatekeepers of knowledge’ to ‘choreographers of learning.’



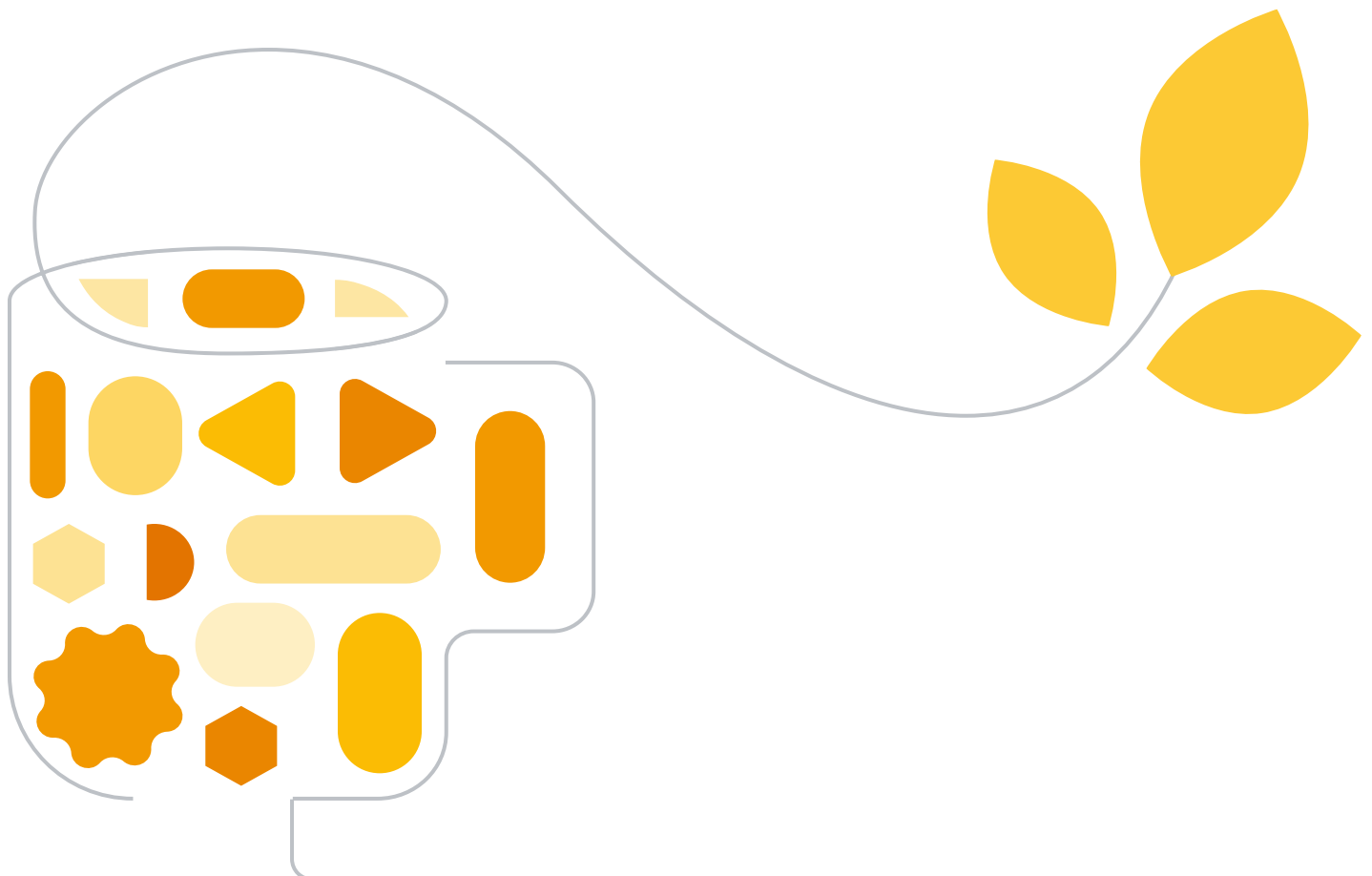


# How will the role of the teacher evolve to support student-centered learning?

The changing role of the teacher has been debated in pedagogical circles for decades. In 1993, associate professor of education at California State University, San Marcos, Alison King, made the case for changing how we think about teachers from “sage on the stage” to “guide on the side.”<sup>35</sup> She argued that the transmittal model of teaching, in which students are passive recipients of a teacher’s knowledge, doesn’t equip students with essential 21st

century skills such as critical thinking, problem-solving, and innovation.

As such, the last few decades have seen a shift away from teacher-centered modes of education, in which the teacher transmits knowledge to students, towards student-centered approaches to learning, where students embrace a more active and collaborative role in their own learning.



“Gone are the days when teachers stood in front of a classroom and just told students what to do or taught them from a traditional textbook. Students are a lot more engaged through digital platforms that allow them to be more autonomous and creative in their learning.

**Keishia Thorpe**

*Global Teacher Prize Winner, 2021, English success coach, United States*

As technology transforms the educational landscape — both in terms of students’ access to information, and the proliferation of personalized and self-directed study options — the idea of the teacher as gatekeeper of knowledge feels even less salient than it once did. The role of the teacher has shifted to one of facilitator and mentor — from providers of knowledge, to designers of learning. Educators still provide access to information, but they now also need to ‘choreograph’ students’ learning experiences, ensuring that they have the

conditions to investigate, evaluate, and collaboratively construct their knowledge from multiple different sources of information and instruction.<sup>36</sup>

While this future role for teachers is necessary and compelling, it also needs to contend with everyday realities. At the same time that teachers are expected to work in this expanded role, schools around the world are reporting a shortage of teachers. It’s a problem which is expected to grow in the future, with UNESCO predicting that 69 million new teachers will be required by 2030, a target unlikely to be met if current trajectories continue.<sup>37</sup>

Elevating the role of teachers is constrained by different factors that negatively impact the status of the profession: low pay, a lack of professional development, and increasing workloads.<sup>38</sup> These challenges were amplified as a result of the Covid-19 pandemic, raising concerns of burnout — a key predictor of teacher attrition.<sup>39</sup>

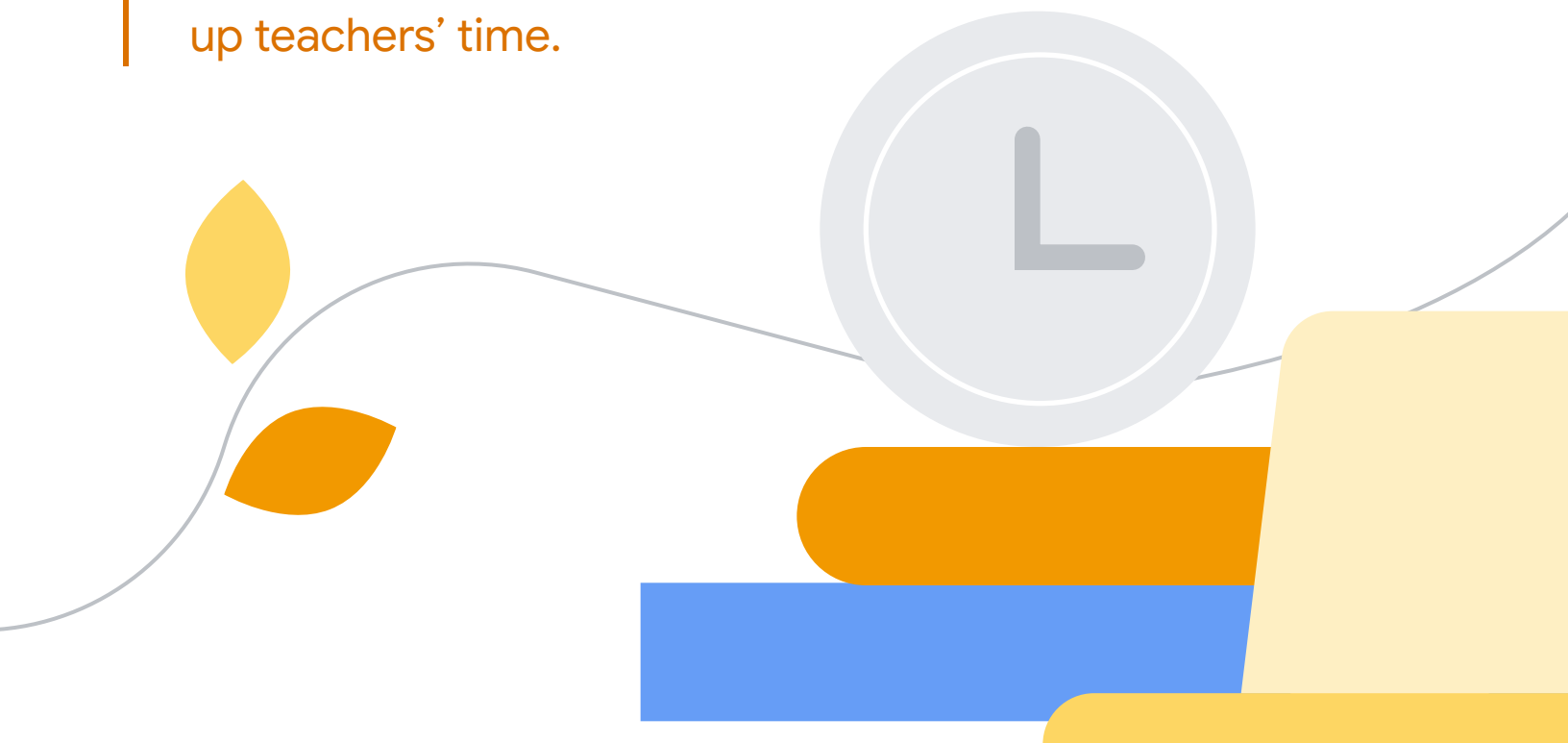


A combination of raising the bar for entry and granting teachers greater autonomy and control over their classrooms and working conditions has helped lift the status of the teaching profession in countries such as Finland.<sup>40</sup> However, the global picture is different: the 2018 Global Teacher Status Index showed that classroom teaching comes close to last when ranking respect for jobs globally, with teachers generally being paid less than the amount people consider to be a fair wage for the job.<sup>41</sup>

Solving these problems requires significant effort; however, one area where technology can play a role is helping to free up teachers' time. Research

suggests that between 20-40% of the tasks teachers spend time on currently — in areas such as grading, lesson planning, and administration — could be outsourced to technology.<sup>42</sup> AI alone could free up 13 hours of teacher time a week by automating certain tasks.<sup>43</sup> Saving hours won't solve teacher turnover alone, but it could help reduce workload, and free up time that can be reinvested into professional development, for example, helping them upskill and network. Not only this, but in the context of the growing field of 'learning analytics,' AI enables teachers to establish a better picture of how students are performing, and understand the most effective way to teach and engage them.

One area where technology can play a role is helping to free up teachers' time.







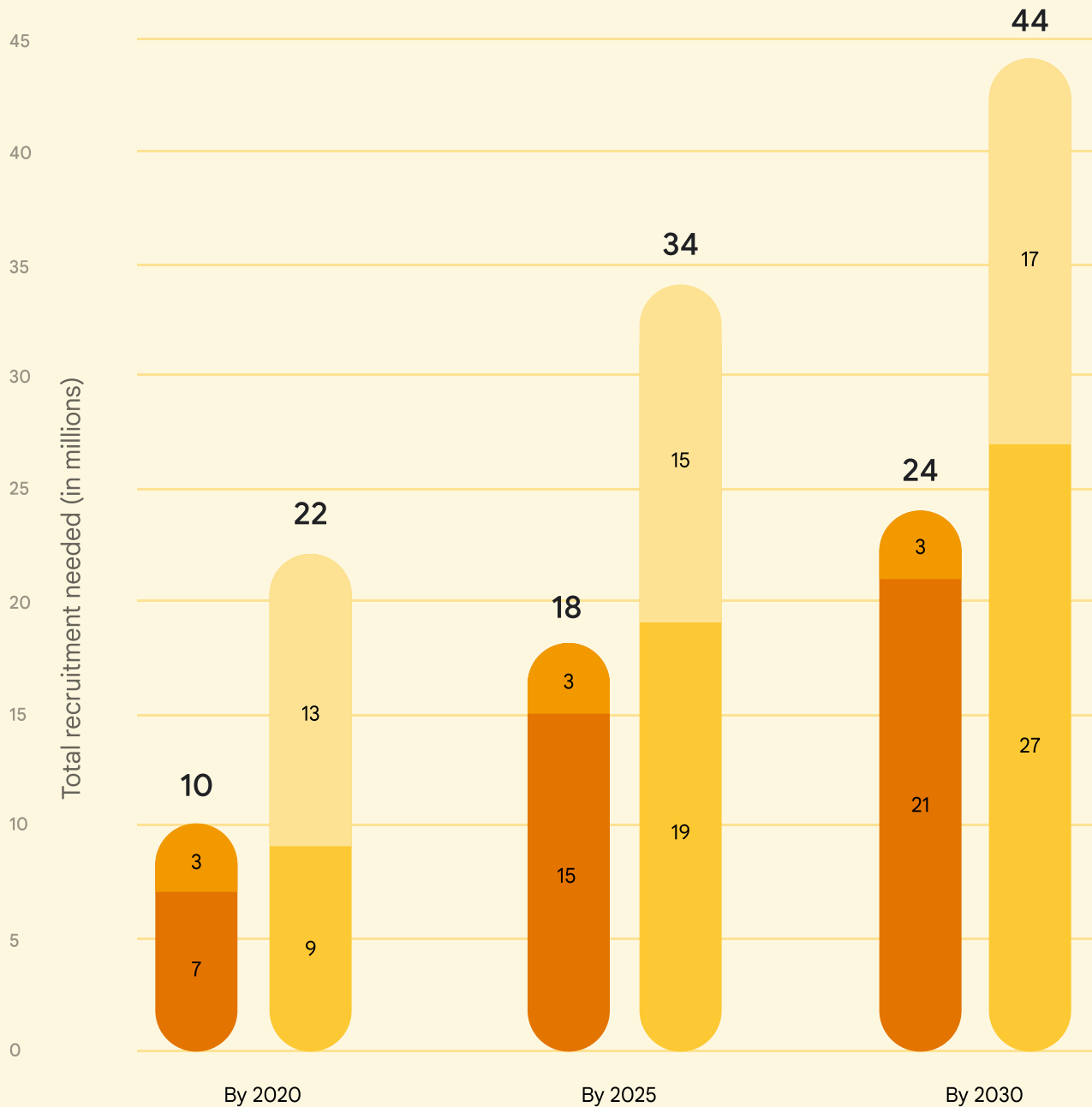
To fully realize these opportunities, teachers will need the time to continually refresh and deepen skills as educational priorities evolve, whether that's data literacy or social and emotional learning. Researchers widely agree that better approaches to professional development for teachers will be essential to keep teachers up to date.<sup>44</sup> Currently the most common method of professional development for teachers is physically attending courses and seminars. Research indicates that less than half of teachers have attended an online course, and only a minority are part of a professional network, even though peer networks are an effective way to support development.<sup>45,46,47</sup> Online platforms, in contrast to traditional seminars or ways of networking, enable teachers to learn and connect in more frequent and timely ways, without having to travel —

creating greater opportunity to support teachers and help them thrive in their role.

As the role of the teacher shifts from 'gatekeepers of knowledge' to 'choreographers of learning,' it's important that the right structures and supports are in place to ensure that teachers can thrive and that the field continues to grow. This includes lifting the global reputation of teaching as a profession, using AI-supported technology to free up teacher time and reduce administrative burdens, and offering teachers greater and more flexible opportunities for ongoing professional development. To evolve how we teach and learn, it is critical that teachers have the tools, time, and respect that they need and deserve, so that they can continue to guide, grow, and inspire their students.

## Number of teachers needed globally by 2030

Global numbers of teachers needed to achieve universal primary and secondary education by five-year intervals: 2020, 2025, and 2030

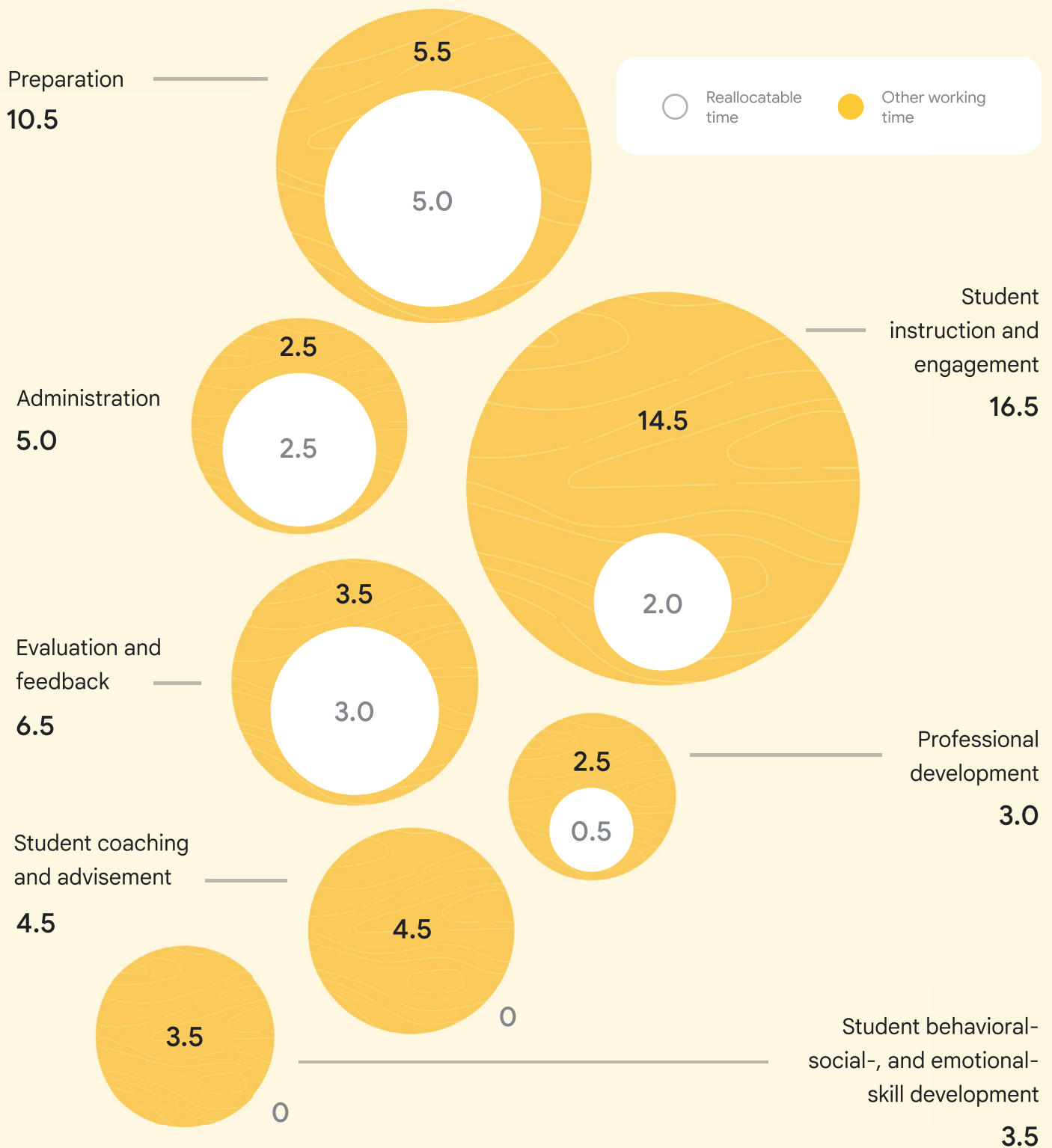


● Replacement for attrition (primary education)
 ● Staffing new classrooms (primary education)
 ● Replacement for attrition (secondary education)
 ● Staffing new classrooms (secondary education)

Source: UNESCO, "The World Needs Almost 69 Million New Teachers to Reach the 2030 Education Goals," 2016

## How AI can save teachers time

Potential for time reallocation, number of hours per week\*



\*Figures may not sum, because of rounding. Average for respondents in Canada, Singapore, United Kingdom, and United States.

Source: McKinsey, "How artificial intelligence will impact K-12 teachers," 2020



“

The power of technology in education [is a major force shaping it], changing learning experiences, changing the role and nature of educators — your work in knowledge transmission is no longer that relevant. You have to instead become a great coach, a great mentor, a social worker, and career advisor.

**Andreas Schleicher**

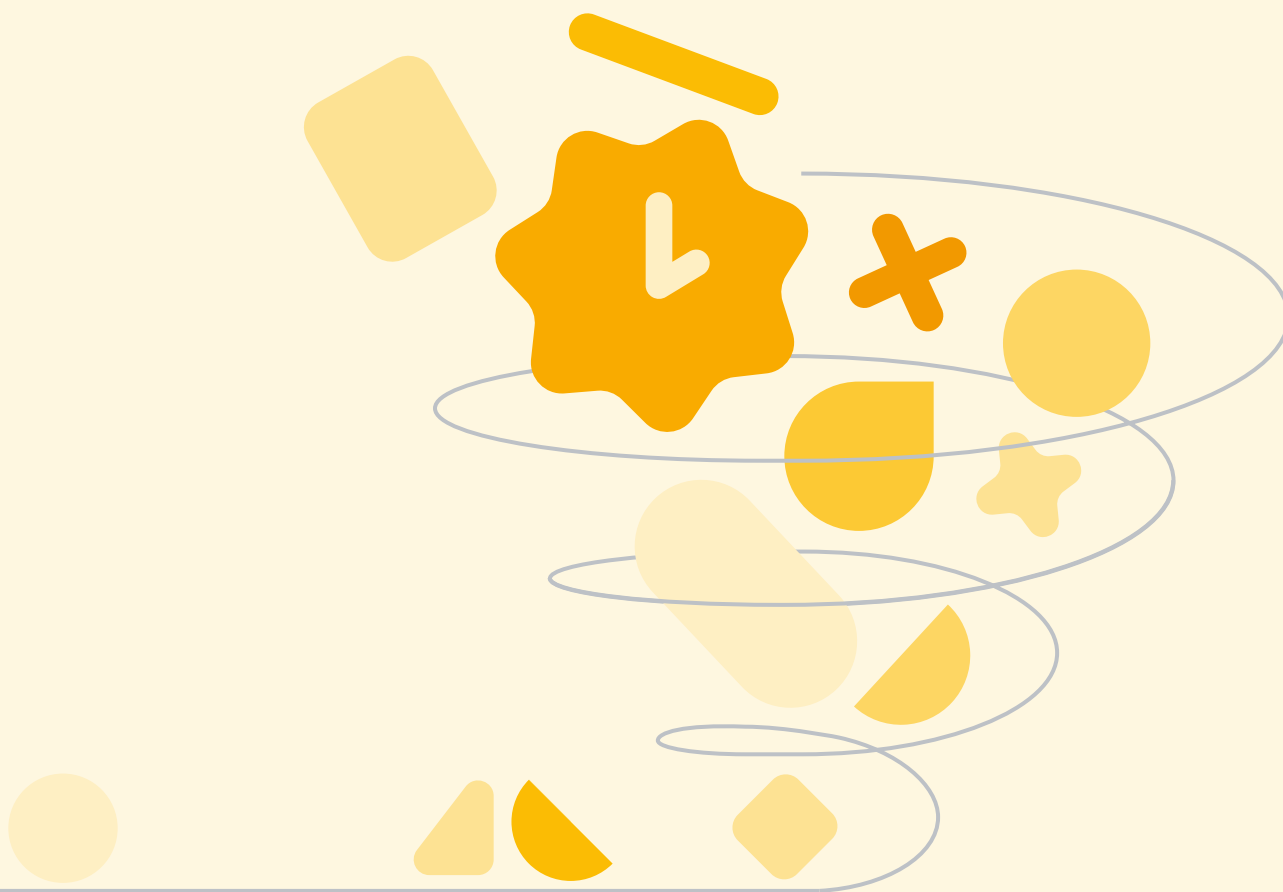
*director for education and skills, and special advisor on education policy to the secretary-general at the Organisation for Economic Co-operation and Development (OECD), Global*



## Ideas in action | *United States*

# Helping teachers save time

Edtech platform Gradescope uses AI to ease the burden of grading for teachers. Students' paper worksheets are scanned to create a PDF which automatically links to each learner's profile. This data enables teachers to see broader patterns to help with student development. Using AI, the tool also sorts similar answers across the class into groups, so teachers can grade by question rather than by student. This means teachers can give one piece of feedback to multiple students without having to shuffle between papers, saving significant amounts of time.<sup>48</sup>

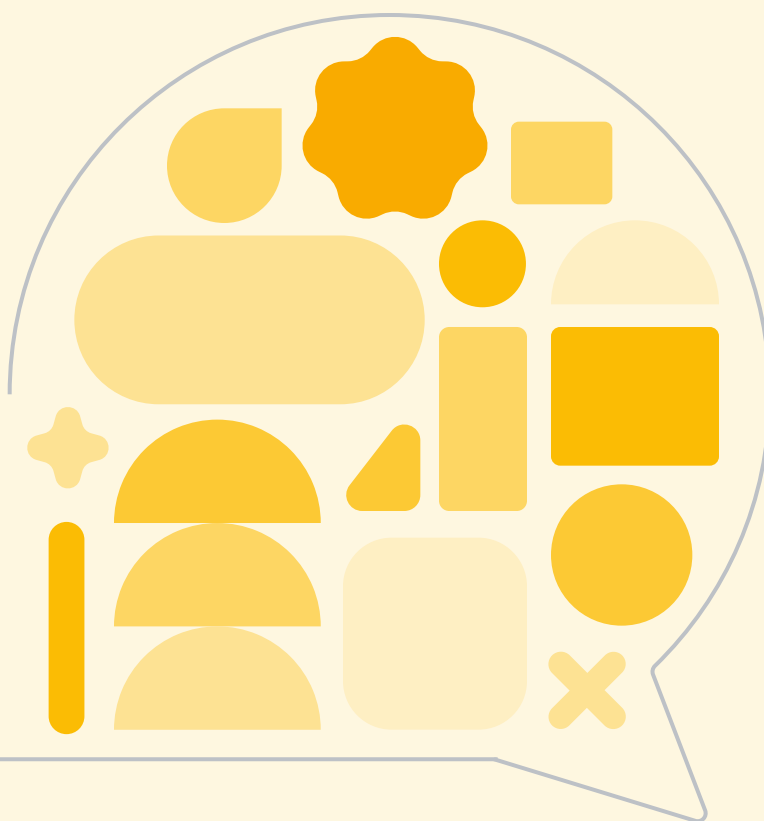




## Ideas in action | France

# Quality online support for teachers

Launched in 2020 by the French Government, TNE (Territoires Numériques Éducatifs) is a free online platform that enables teachers to take part in online training courses, and access a bank of recognized, royalty-free teaching resources. The goal is to raise teacher understanding and confidence with a range of subjects related to digital technologies. To help extend the reach of the materials, parents are also able to access some of the training.<sup>49</sup>







Ideas in action | *Global*

## Raising the profile of teachers globally

The Global Teacher Prize is an annual \$1 million award that seeks to acknowledge one teacher who has made an extraordinary contribution to the profession. The top 50 finalists from each cohort join a collective of Global Teacher Prize Ambassadors. By recognizing and celebrating teachers for their work, the prize aims to raise the profile of the profession on the global stage. Since its founding in 2015, 300 ambassadors have joined the Global Teacher Prize Community, shifting perceptions of the teaching profession, as well as influencing policy and practice in over 60 countries around the world.<sup>50</sup>





# The Google perspective

## Elevating the teacher

At Google, we believe that advances in technology have the potential to create the conditions for a golden age of teaching, where teachers can cater to the specific needs of their students and learning is personal. For example, AI-supported technology can help teachers save time on administrative work, and reinvest it in teaching and professional development. At the same time, students have access to more information than ever before, and teachers are uniquely positioned to serve as guides, helping students get the most out of their learning experiences.





We work each day to push the limits of what's possible when technology is seamlessly integrated into the teaching and learning experience. It's this mindset that drove the creation of [Google Classroom](#), to help simplify teaching and learning by streamlining teacher workflows. In the past, a teacher's workflow might have looked something like this: create an assignment; make paper copies at the copy machine; hand the assignment to each student for completion; manually grade each assignment; and provide students with grades and feedback the following week. Not only is this process timely and manual, but it takes away valuable time that could have been spent getting to know each student or offering more timely support. Further to this, traditional teacher workflows can make it challenging to provide quick snapshots of class performance or help

teachers effectively monitor individual learning patterns over time. With Classroom, teachers can easily create an assignment; make and distribute digital copies; receive student responses in real-time; have assignments auto-graded; and view both class and individual performance — all in just a few clicks. We believe that tools like this can help students and teachers move faster and more efficiently, freeing up time for what matters most — the magic that is teaching. For written assignments that require a more in-depth review, teachers can take a once lengthy process — checking for plagiarism — and accomplish it with a single click: With [Originality Reports](#), a feature in Classroom, teachers use the power of Google Search to compare student work against hundreds of billions of web pages and over 40 million books.



With Google Workspace for Education, we provide teachers with a suite of easy-to-use tools that help enhance teaching and learning for everyone. Google Forms, for example, allows teachers to create materials that previously required large investments of time. This includes creating class surveys or check-ins, building formative assessments, and collecting useful class data. To help teachers organize tasks or map out lesson plans, we offer interactive checklists and smart chips in Google Docs. Teachers can tag people, assign tasks and dates, easily embed Drive files, mark items as complete, and more.

As we develop tools to elevate the teaching experience, flexibility is top of mind. The Screencast app, built into ChromeOS, allows both students and teachers to deliver and record content that can be viewed at any time. In addition, content creators can record, trim, transcribe, and share lessons or demos to build a custom library of recordings. They can draw or write on the screen using a touchscreen or stylus to diagram or illustrate key concepts, and can easily edit their video, just by removing the associated part of the transcript. To help make content more accessible, students have the option to translate the transcript to their chosen language.



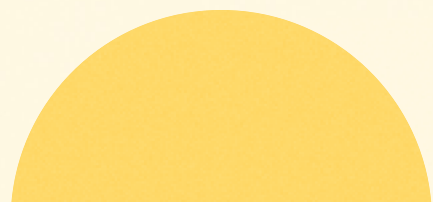
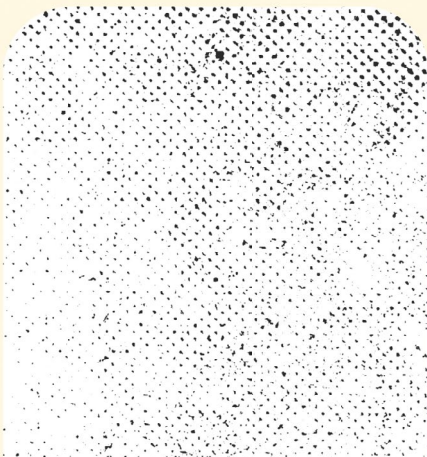
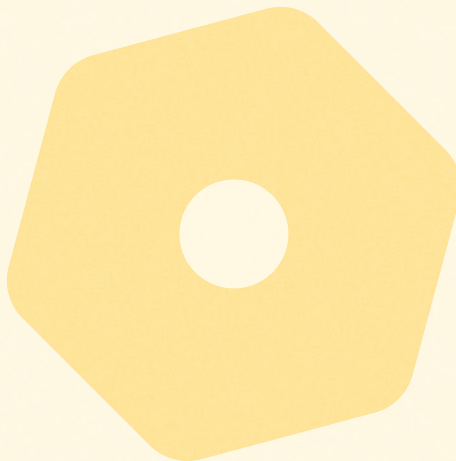


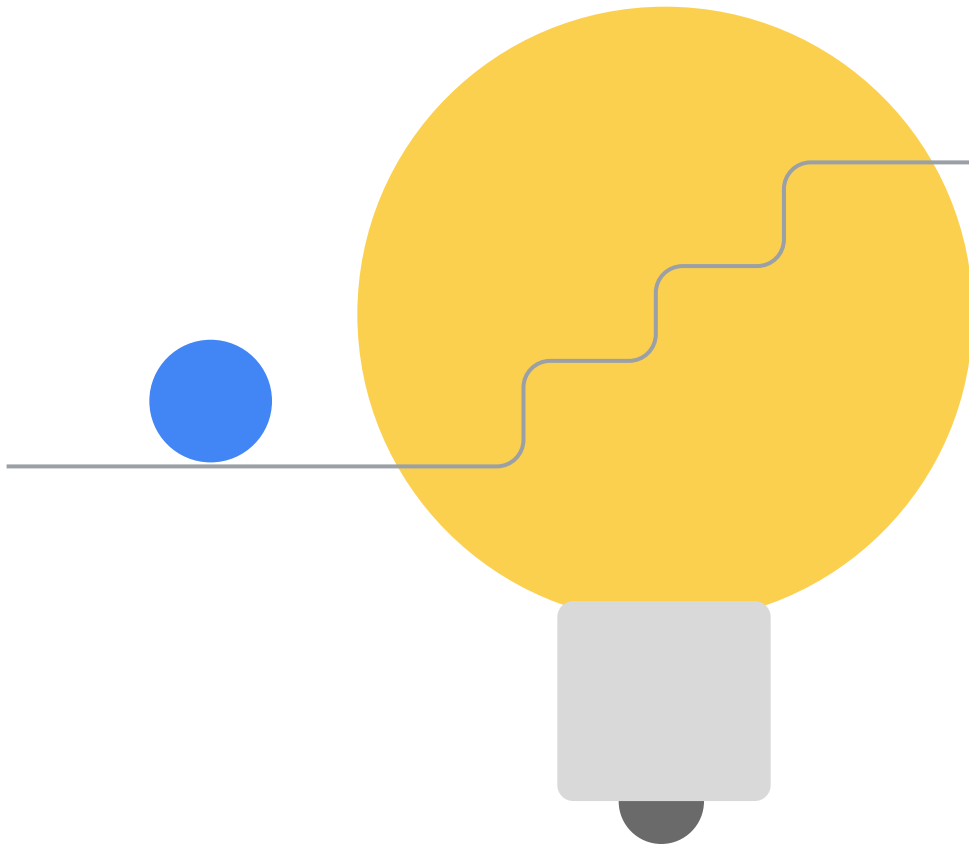
At Google, we believe in the promise of technology to help advance teaching and learning; from reducing administrative burden and simplifying processes, to surfacing student learning patterns faster and helping to make lessons more collaborative and engaging. When we give teachers the tools — and time — they need to do their best work, amazing things happen. As we look at the next 5-10 years, we know that while the role of the teacher might change, their ability to transform the lives of their students will continue to grow. It is one of the many reasons why our relationships with teachers are core to the work that we do; they are our beta testers, informal consultants, and the inspiration for so many of the features we build and the improvements we make.

When we elevate teachers, we elevate learning.

When we elevate  
teachers, we  
elevate learning.







Visit [learning.google](https://learning.google)  
to learn more about our goal to  
help everyone in the world learn  
anything in the world.



# Glossary

## Adaptive learning

A type of learning where students are given customized resources and activities to address their unique learning needs.<sup>51</sup>

## Artificial intelligence (AI)

A set of technologies that enable computers to perform a variety of advanced functions.<sup>52</sup>

## Assistive technologies (AT)

Products, equipment, and systems that enhance learning, working, and daily living for persons with disabilities.<sup>53</sup>

## Augmented reality (AR)

The real-time use of information in the form of text, graphics, audio and other virtual enhancements integrated with real-world objects.<sup>54</sup>

## Deep learning technologies

A subset of machine learning and artificial intelligence that is driving breakthroughs in areas like speech recognition, visual object recognition, object detection, drug discovery, genomics and many other data-rich fields.<sup>55</sup>

## Differentiation

Instruction that is tailored to the learning preferences of different learners. Learning goals are the same for all students, but the method or approach of instruction varies according to the preferences of each student or what research has found works best for students like them.<sup>56</sup>

## Digital assistants

A computer program or device that is connected to the internet and can understand spoken questions and instructions, designed to find answers to questions.<sup>57</sup>

## Experiential learning

An engaged learning process whereby students “learn by doing” and by reflecting on the experience.<sup>58</sup>

## E-Learning

The acquisition of competencies, knowledge, and skills through electronic media, such as the Internet or a company Intranet.<sup>59</sup>

## Game-based learning

A type of game play with defined learning outcomes.<sup>60</sup>

## Gamification

An approach for increasing learners’ motivation and engagement by incorporating game design elements in educational environments.<sup>61</sup>

## Individualization

Instruction that is paced to the learning needs of different learners. Learning goals are the same for all students, but students can progress through the material at different speeds according to their learning needs. For example, students might take longer to progress through a given topic, skip topics that cover information they already know, or repeat topics they need more help on.<sup>62</sup>

## Learning loss

Any specific or general loss of knowledge and skills or reversals in academic progress, most commonly due to extended gaps or discontinuities in a student’s education.<sup>63</sup>

## Metaverse

A virtual reality space in which users can interact with an environment generated by computer and with other users.<sup>64</sup>

## Personalization

Instruction that is paced to learning needs, tailored to learning preferences, and tailored to the specific interests of different learners. In an environment that is fully personalized, the learning objectives and content as well as the method and pace may all vary (so personalization encompasses differentiation and individualization).<sup>65</sup>

## Project based learning

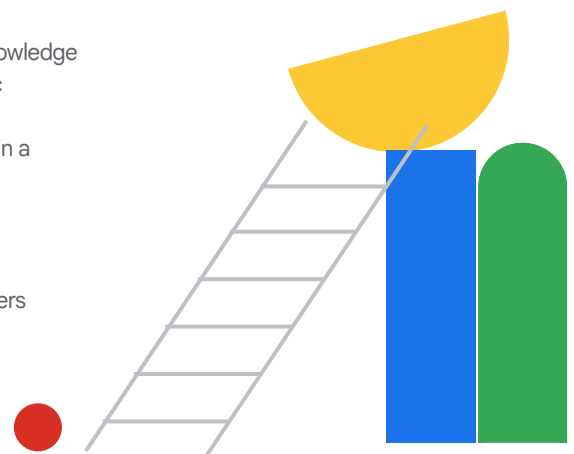
A teaching method in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge.<sup>66</sup>

## STEM education

An interdisciplinary teaching method that integrates science, technology, engineering, mathematics, and other knowledge, skills, and beliefs particular to these disciplines.<sup>67</sup>

## Virtual reality (VR)

A set of images and sounds, produced by a computer, that seem to represent a place or a situation that a person can take part in.<sup>68</sup>





# Our research approach

It is Google's goal to help learners develop the knowledge, mindsets, skill sets, and tool sets necessary to thrive in a transforming world and actively co-construct a flourishing, diverse and equitable society.

Supporting this ambition, in collaboration with our research partner Canvas8, we conducted a global study to better understand the emerging shape of tomorrow's education ecosystem.

## Methodology

### Our study took us around the world, including

- 94 in-depth expert interviews with global and country-specific thought leaders in education, including experts in policy, academic researchers covering education, district-level representatives, school principals and teachers and edtech leaders.
- Academic literature review focusing on the last two years of peer-reviewed publications, and desk research and media narrative analysis<sup>‡</sup> across the education sector, including policy research and teacher surveys.

### Macro questions we asked

- How do we expect education to evolve over the next 5-10 years?
- What are the implications of macro trends on education and schools?
- What are the emerging education technology trends in each market?

### Our process

- Interviews were conducted with a panel of international experts to identify the forces shaping the education landscape.
- The interview transcripts were coded to create initial hypotheses which informed a discussion guide for local market interviews.
- Local market interviews were coded by local contributors to identify the most prevalent themes across markets.
- Workshops with experts and consultants helped refine the articulation and organization of the themes.
- Finally, desk research was conducted to elaborate the themes, providing additional theory and context for the readers.

Interviews were conducted between March 2022 and July 2022.

### Countries included in the study

Austria, Australia, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, India, Indonesia, Italy, Ireland, Japan, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, the United Kingdom, and the United States of America. The central focus was primary and secondary education (K-12), with acknowledgement to how the trends are also impacting post-secondary education.

### Research partner and advisor

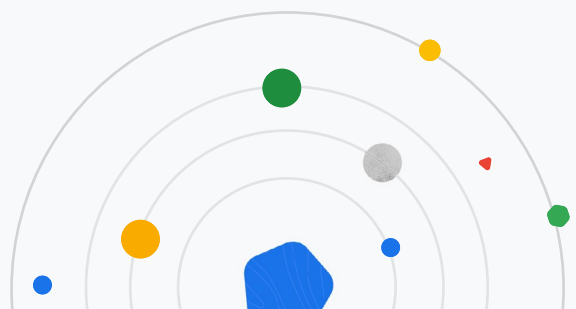
Canvas8 ([www.canvas8.com](http://www.canvas8.com)) is an award-winning strategic insights practice operating out of London, LA, New York, and Singapore. Its focus is on enabling organizations to be better, by understanding changes in human culture and behavior.

Global nonprofit American Institutes for Research (AIR) ([www.air.org](http://www.air.org)) served as an advisor and consultant to this research. Founded in 1946, AIR is one of the largest behavioral and social science research and evaluation organizations in the world. Its mission is to generate and use rigorous evidence that contributes to a better, more equitable world.

## Limitations

This work is not intended to be a definitive or comprehensive view of the future of education. It aims to bring together a range of expert perspectives from around the world, and across the education ecosystem, to provide a picture of some of the key trends that will be shaping the future, especially when considering the role of technology. The views and opinions expressed in this report are those of the experts and do not necessarily reflect the views or positions of any entities, institutions or organizations they represent. This report is intended to provide a global view of trends that are relevant across 24 countries. It also acknowledges that each country is different and that there are significant variations within markets. By taking a big picture view, we aim to help educators identify common challenges, ideas, and opportunities around the world.

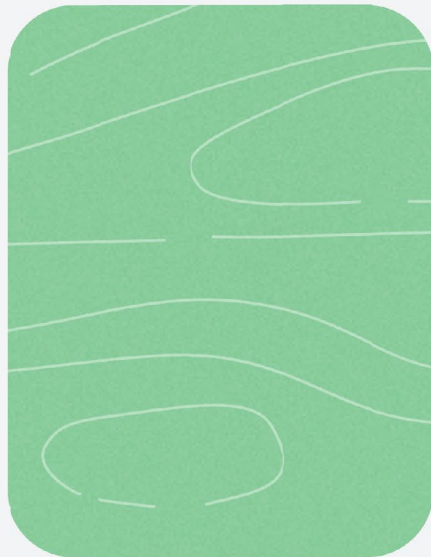
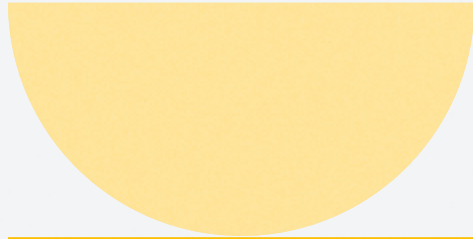
<sup>‡</sup> Using media intelligence platform NetBase Quid ([www.netbasequid.com](http://www.netbasequid.com)), we conducted a "future of education" keyword search across global English-language media sources, covering the five-year period from December 2016 - December 2021. This surfaced important events and topics, which fed into the global analysis.



# References

- 1 Jobs for the Future and Nellie Mae Education Foundation, "Motivation, Engagement, And Student Voice," 2012
- 2 U.S. Department of Education, Office of Educational Technology, "Learning Powered by Technology," 2010
- 3 U.S. Department of Education, Office of Educational Technology, "Learning Powered by Technology," 2010
- 4 U.S. Department of Education, Office of Educational Technology, "Learning Powered by Technology," 2010
- 5 npj Science of Learning, "Towards AI-powered personalization in MOOC learning," 2017
- 6 Evening Standard, "Parents turn to Alexa and Google Home to help with 'harder' school homework," 2022
- 7 Canalys, "Global smart speaker market 2021 forecast," 2020
- 8 Ansari and Christodoulou, "Mind, brain, & education: Neuroscience implications for the classroom," 2010
- 9 OECD, "PISA, Chapter 9, "Sense of belonging at school," 2018
- 10 Edutopia, "A Troubling Lack of Diversity in Educational Materials," 2022
- 11 Educational Technology Research and Development, "Assistive technology for the inclusion of students with disabilities: a systematic review," 2022
- 12 Iris Center, "Assistive Technology Module," Accessed: 2022
- 13 Carnegie Learning, "An ESSA Evidence-Based Approach," 2018
- 14 Israel Hayom, "'Digital human company' brings Albert Einstein back to life through AI," 2021
- 15 2020 IEEE Frontiers in Education Conference, "Tackling Gender Stereotypes in STEM Educational Resources," 2020; Nature Machine Intelligence, "AI-generated characters for supporting personalized learning and well-being," 2021
- 16 Forbes, "Envision Smart Glasses – A Game-Changer In Helping Blind People Master Their Environment," 2021
- 17 Our World in Data, "Share of US households using specific technologies, 1860 – 2019," 2019
- 18 Educause Review, "Mixed Reality: A Revolutionary Breakthrough in Teaching and Learning," 2018
- 19 Forbes, "Virtual Reality: THE Learning Aid Of The 21st Century," 2019
- 20 Kolb, "Experiential Learning: Experience As The Source Of Learning And Development," 1984
- 21 Meridian Treehouse, "An Introduction to Learning in the Metaverse," 2022; Physics Education, "How augmented reality enhances typical classroom experiments," 2020; American Nuclear Society, "Virtual Field Trips," 2021
- 22 Newzoo, "Global Games Market Report," 2022
- 23 Educational Psychologist, "Foundations of Game-Based Learning," 2015
- 24 Journal of Cyberpsychology, Behavior, and Social Networking, "Gaming Mindsets: Implicit Theories in Serious Game Learning," 2012
- 25 Journal of Cyberpsychology, Behavior, and Social Networking, "Gaming Mindsets: Implicit Theories in Serious Game Learning," 2012
- 26 Computers in Human Behavior, "Revealing the theoretical basis of gamification," 2021
- 27 UNESCO, "Rethinking Learning," 2020
- 28 Computers & Education, "The effect of using Kahoot! for learning – A literature review," 2020
- 29 Save the Children, "Assessing the Impacts of Literacy Learning Games for Syrian Refugee Children: An executive overview of Antura and the Letters and Feed the Monster Impact Evaluations," 2018
- 30 British Educational Research Association, "The virtual field trip: Investigating how to optimize immersive virtual learning in climate change education," 2020
- 31 MIT Media Lab, "Overview < Deep Empathy," 2018
- 32 Fast Company, "'Roblox' isn't just a gaming company. It's also the future of education," 2021
- 33 Variety, "'Roblox' Digital Civility Effort Teaches It's Cool to be Kind," 2019
- 34 Desmos, "About Desmos Studio," Accessed: 2022
- 35 College Teaching, "From Sage on the Stage to Guide on the Side," 1993

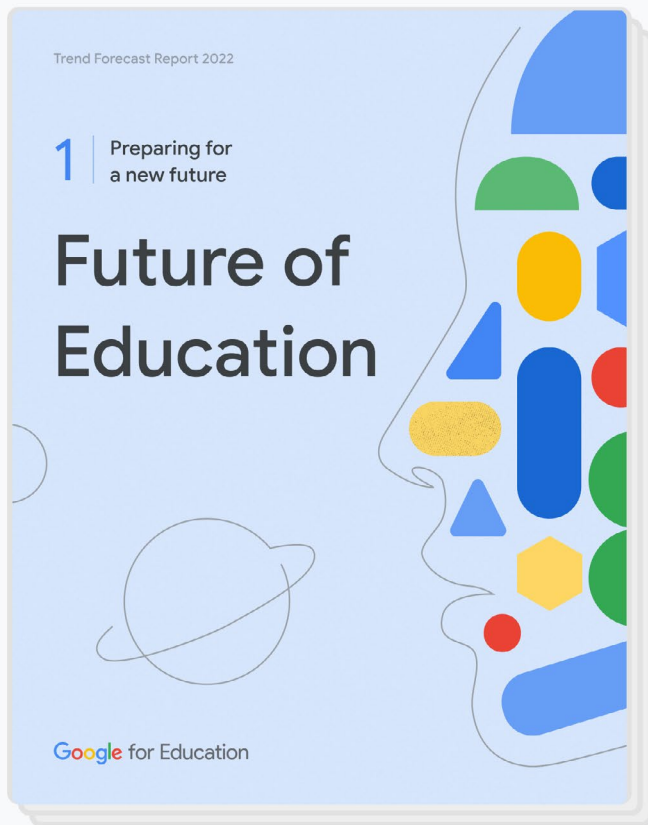
- 36 Research in Learning Technology, "[Learning Design: reflections on a snapshot of the current landscape](#)," 2012
- 37 UNESCO, "[The World needs almost 69 million new teachers to reach the 2030 Education goals](#)," 2016
- 38 Economic Policy Institute, "[The teacher shortage is real, large and growing, and worse than we thought](#)," 2019
- 39 Frontiers in Psychiatry, "[Teachers' Burnout Risk During the Covid-19 Pandemic](#)," 2022; University of York, "[Teacher burnout causing exodus from the profession, study finds](#)," 2021; Varkey Foundation, "[Global Teacher Status Index 2018](#)," 2018
- 40 Beijing International Review of Education, "[Thoughts on the Future of Teaching](#)," 2019
- 41 Varkey Foundation, "[Global Teacher Status Index 2018](#)," 2018
- 42 McKinsey, "[How artificial intelligence will impact K-12 teachers](#)," 2020
- 43 McKinsey, "[How artificial intelligence will impact K-12 teachers](#)," 2020
- 44 International Journal of Educational Research Open, "[Patterns of teacher collaboration, professional development and teaching practices](#)," 2022
- 45 OECD, "[TALIS, Chapter 5, Providing opportunities for continuous development](#)," 2018
- 46 Journal of Educational Change, "[Professional learning networks: From teacher learning to school improvement?](#)" 2021
- 47 OECD, "[TALIS, Chapter 5, Providing opportunities for continuous development](#)," 2018
- 48 UMass Lowell, "[AI-powered Grading Software Earns High Marks](#)," 2020
- 49 Canopé, "[Territoires Numériques Éducatifs](#)," Accessed: 2022
- 50 Varkey Foundation, "[Global Teacher Prize](#)," Accessed: 2022
- 51 Google, "[Let's get personal: adaptive learning tech and education](#)," 2022
- 52 Google Cloud, "[What Is Artificial Intelligence \(AI\)?](#)," Accessed: 2022
- 53 Assistive Technology Industry Association, "[What is AT?](#)," Accessed: 2022
- 54 Gartner, "[Definition of Augmented Reality \(AR\)](#)," Accessed 2022
- 55 Adapted from Nature, "[Deep learning](#)," 2015
- 56 U.S. Department of Education, Office of Educational Technology, "[Learning Powered by Technology](#)," 2010
- 57 Adapted from Cambridge English Dictionary, "[Digital Personal Assistant](#)," Accessed: 2022
- 58 Boston University Center for Teaching & Learning, "[Experiential Learning](#)," Accessed: 2022
- 59 Oxford Reference, "[E-Learning](#)," Accessed: 2022
- 60 Educational Psychologist, "[Foundations of Game-Based Learning](#)," 2015
- 61 International Journal of Educational Technology in Higher Education, "[Gamifying education: what is known, what is believed and what remains uncertain: a critical review](#)," 2017
- 62 U.S. Department of Education, Office of Educational Technology, "[Learning Powered by Technology](#)," 2010
- 63 The Glossary of Education Reform, "[Learning Loss Definition](#)," Accessed: 2022
- 64 Oxford Learner's Dictionaries, "[Metaverse](#)," Accessed 2022
- 65 U.S. Department of Education, Office of Educational Technology, "[Learning Powered by Technology](#)," 2010
- 66 PBLWorks, "[What is Project Based Learning?](#)" Accessed: 2022
- 67 Journal of Science Education, "[What are we talking about when we talk about STEM education?](#)" 2019
- 68 Adapted from Cambridge English Dictionary, "[Virtual Reality](#)," Accessed: 2022





## Related reports

“Evolving how we teach and learn” is the second installment of the Future of Education report. Check out Part 1 below, and stay tuned for Part 3: Reimagining learning ecosystems.



### PART 1

#### Preparing for a new future

The future is shaping up to look radically different from today. As educators work to equip students with the skills and mindsets they'll need to navigate massive change and prepare for a new future, the educational experts we interviewed discussed how and why they're rethinking the role of education.

 [View report](#)

## ABOUT GOOGLE FOR EDUCATION

# Products that power education

Google for Education tools work together to transform teaching and learning so every student and educator can pursue their personal potential.



## Google Workspace for Education

Make collaboration easier, streamline instruction, and keep your learning environment secure with Google Workspace for Education. You can select from tools available without cost, or add enhanced capabilities to suit the needs of your institution.

[Learn more →](#)



## Google Classroom

Google Classroom is your all-in-one place for teaching and learning. Our easy-to-use and secure tool helps educators manage, measure, and enrich learning experiences.

[Learn more →](#)



## Google Chromebooks

A range of simple yet powerful devices with built-in accessibility and security features to deepen classroom connections and keep user information safe.

[Learn more →](#)



Google for Education

Learn more at [edu.google.com](https://edu.google.com).