REINVENT
LEARNING

# New Realities in Education

How virtual reality and augmented reality can help students succeed in the age of experience

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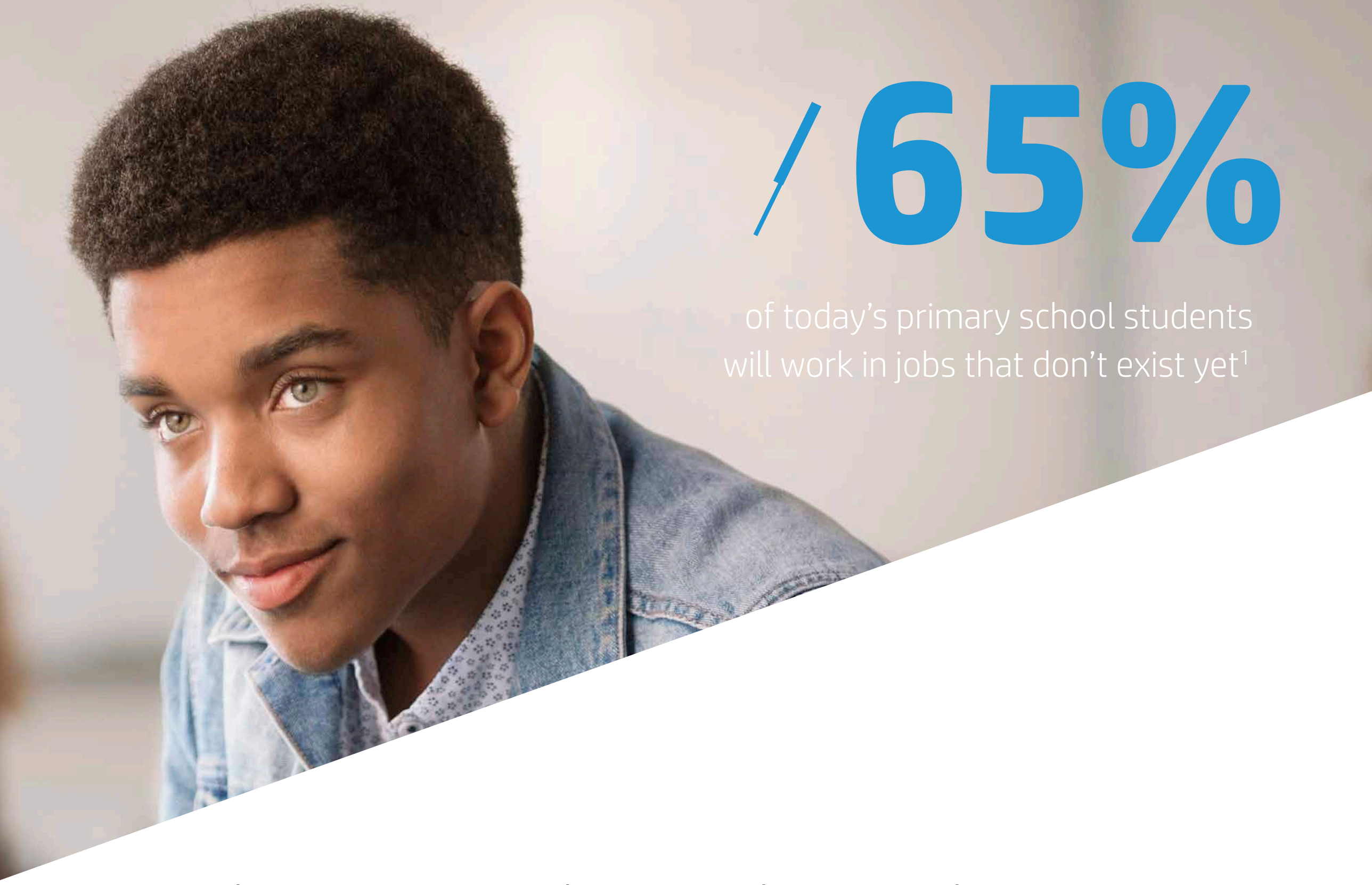
# 1.0 / INTRODUCTION




## Education must take an evolutionary leap

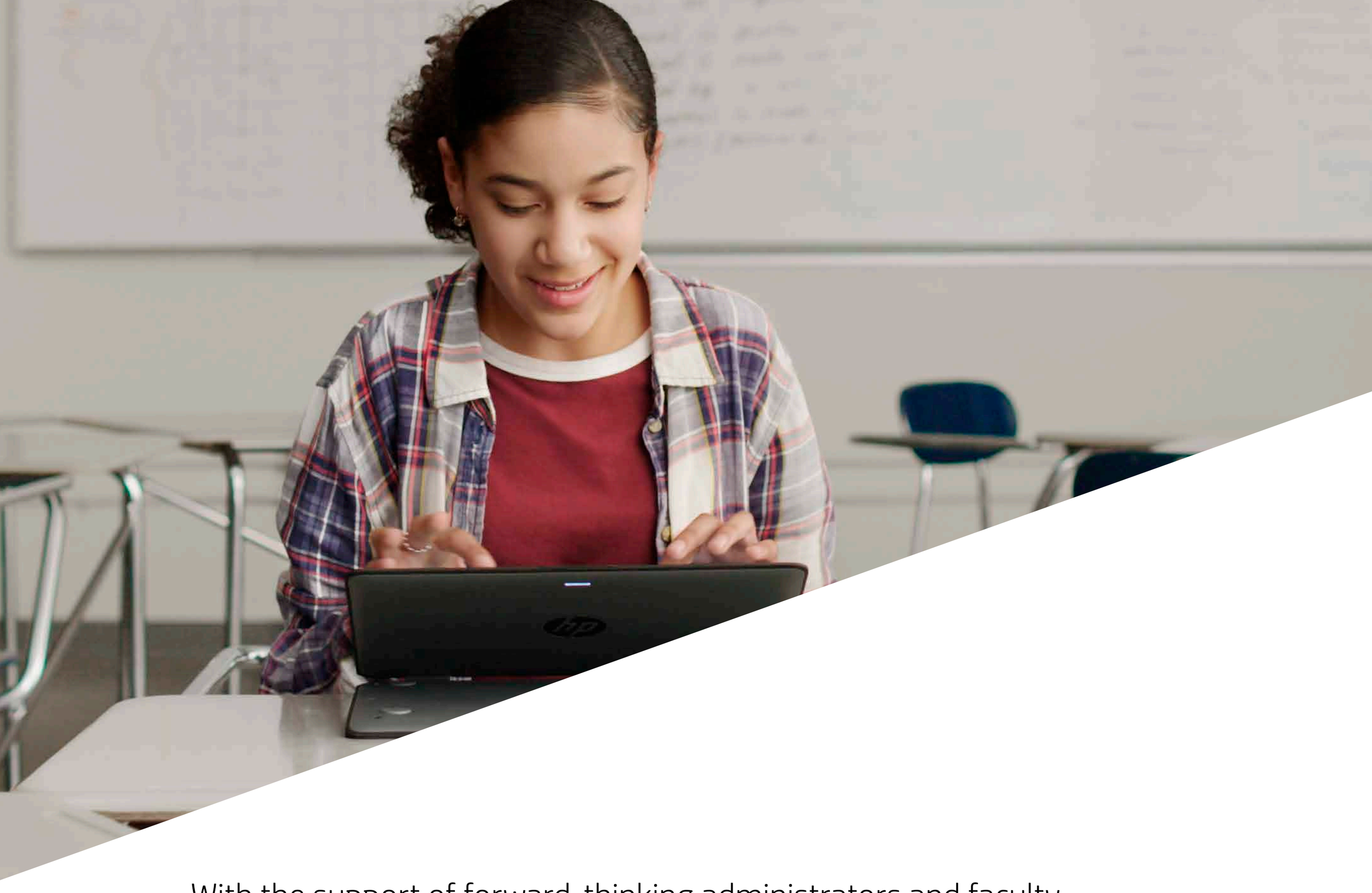
It's predicted that 65 percent of today's primary school students will work in jobs that don't exist yet. As this staggering number continues to rise, schools are left wondering how to adapt. Methodologies are being challenged, curricula are changing, new technologies are being tested—and educators are struggling to keep up.

## One thing is apparent: It's time to reinvent the classroom to prepare students for the future, not the past.

Eighty-six percent of parents and teachers in the United States and 90 percent of those in China[2] agree on the importance of technology in the classroom. Changes brought about by a digital society are imminent and the evolution of the classroom is imperative.

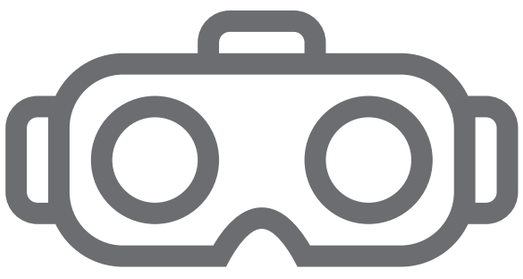
According to Christopher Dede, Timothy E. Wirth Professor in Learning Technologies at Harvard's Graduate School of Education, *"Today's students need to become really good at learning—not just in academic settings—but when academic life is over, because you're going to be living in a world that's changing around you your entire life."*

XR, or "X Reality" (the term given to virtual reality, augmented reality and mixed reality), allows educators to build that bridge between academics and real-world applications. It helps schools transform student experiences from an industrialized education system of the past to a student-first, collaborative system designed to better equip tomorrow's leaders for next-generation careers.*



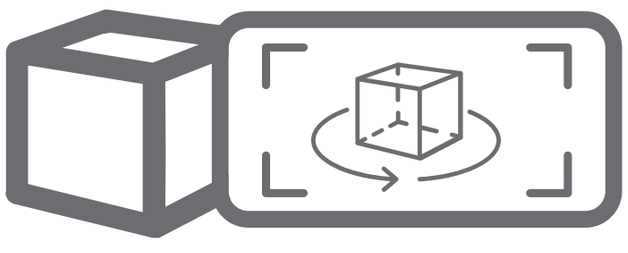
With the support of forward-thinking administrators and faculty, XR is making its way into innovative learning spaces. While these advancements create greater learning opportunities, the rapid pace of innovation leaves schools even more vulnerable to falling behind.

Learn more about these tools so you can wield them to their full potential and mitigate the barriers to access, adoption and engagement that often come along with them. The age of experience has arrived. How effectively will you prepare your students?



## Virtual reality (VR)

Set entirely in a virtual world without real-world visual context



## Augmented reality (AR)

Set in the real world with contextual digital elements overlaid

## Mixed reality (MR)

A blend of physical and digital worlds

# What's the difference between VR and AR?

VR refers to computer-generated environments that simulate the physical presence of people and/or objects and realistic sensory experiences,[3] whereas AR overlays digital information on real-world objects using technology such as special glasses or the camera on a tablet or smartphone.[4]

Therefore, VR is set in a virtual world without real world visual context, and AR is set in the real world with contextual digital elements overlaid.

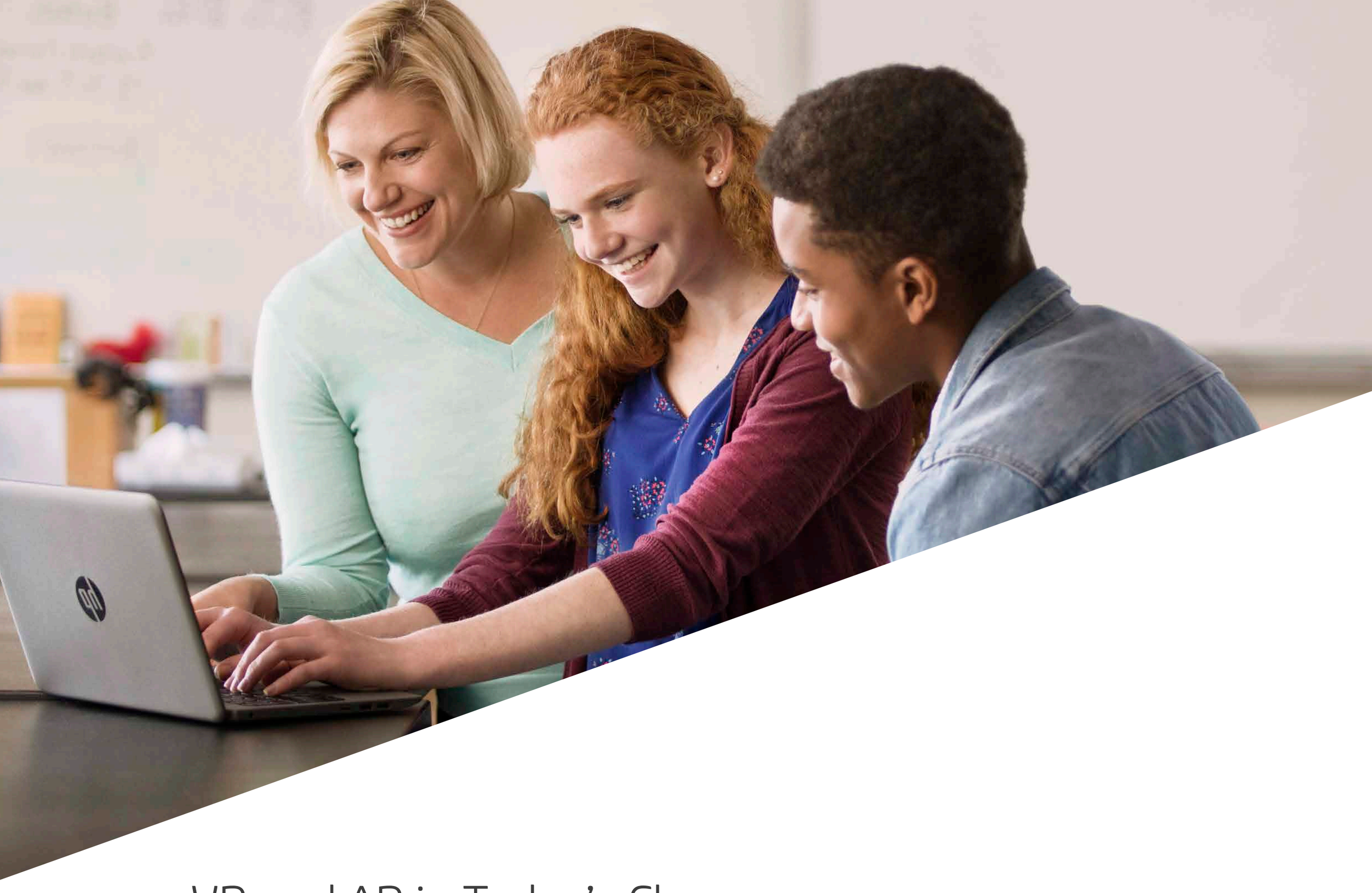
While VR and AR are two of the latest technologies that have emerged in recent years, the question remains: Should they be incorporated into the primary and secondary classroom, and if so, how?

Beyond the wow factor that such technologies afford, VR and AR can support learning goals for school-age children in several ways:

- **Improve collaboration skills** through interacting with classmates on project-based activities and/or shared devices.
- **Exercise creativity** by arranging music, designing characters, building 3D models and much more.
- **Develop emotional intelligence** through social and emotional learning (SEL) exercises, including immersive activities that teach empathy so users can more fully understand the experience of someone seemingly unlike him or her.
- **Inspire engagement and intellectual curiosity** during student-directed activities and exploration, such as virtual field trips.
- **Use various storytelling techniques and mediums,** including interactive narratives and 360-degree videos.
- **Comprehend complex concepts** by viewing processes, organisms and environments students ordinarily wouldn't be able to see firsthand.

Three-dimensional technology enables educators to provide legitimate context around information. *"It's no longer decontextualized from something that students actually care about and becomes much more embedded in our children's education,"* says Eric Klopfer, Director of MIT's Scheller Teacher Education Program and the Education Arcade.

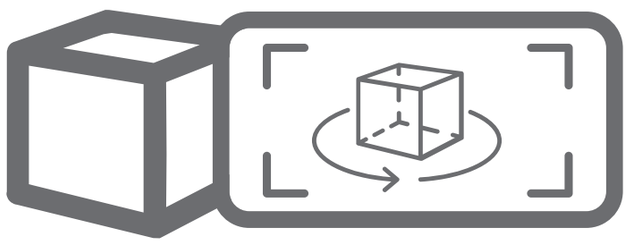
# 2.0 / VR AND AR IN TODAY'S CLASSROOMS



# VR and AR in Today's Classrooms

Virtual reality and augmented reality are still emerging technologies, particularly in primary and secondary schools, and many teachers are unsure how to use them for teaching and learning. Since students are often among the earliest adopters of new technologies, they may be more familiar with the devices than the instructors.

A mere nine percent of U.S. teachers use AR in their classrooms, and an even smaller portion, five percent, use VR. Certain visionary educators have used these tools with success, however, and can serve as models for others who would like to introduce them into their classrooms.

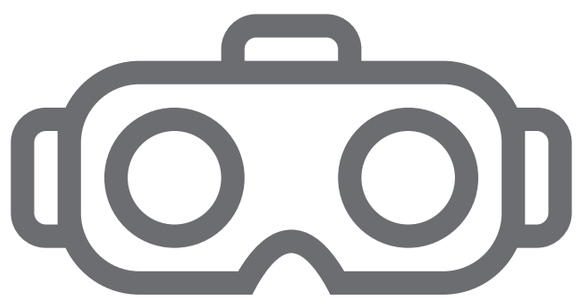


Use AR in the classroom:[4]

9%
**teachers in the U.S.**

13%
**teachers in the U.K.**

21%
**teachers in China**



Use VR in the classroom:[4]

5%
**teachers in the U.S.**

10%
**teachers in the U.K.**

5%
**teachers in China**

### AR can provide:

- Interactive group learning experiences
- Digital engagement with real-world objects
- Virtual training within native environments
- Engaging storytelling
- And more

### VR can enable immersive:

- Virtual field trips and collaboration
- Nanoscale immersion (e.g. in a cell)
- Astrophysical contextualization
- Simulations for training
- And more

Did you know?
VR can minimize the initial discomfort and apprehension some students feel when participating in educational role-playing activities.

## Real classrooms use AR

### Bearden Middle School

Lauren Waldron, a sixth-grade math teacher at Bearden Middle School in Knoxville, Tenn., uses AR as a tool for providing timely assistance to students who are stuck on a problem. Using Aurasma, an app, the student scans an image with his or her device and then is able to access a video that includes a clue, such as a formula, to help him or her to solve the problem.

Waldron still circulates among the classroom to impart personal assistance and instruction, but AR enables her to support more students at a time. Students receive aid the moment they need it, instead of having to wait until the teacher is finished coaching another student. In this way, VR and AR can help mend the gap in overcrowded classrooms. Waldron's English language learners and special education students, in particular, enjoy the opportunity these tools give them to work independently.

### Externat St-Jean-Berchmans

A Canadian primary school in Québec City introduced SAGA's interactive gym to the delight of its students. In one AR game, floating shapes are projected onto the walls of the gym while the class hurls rubber balls at the moving images. If a student hits one of the shapes, it audibly and visually bursts. The virtual components are an exciting complement to the physical activity students at Externat St-Jean-Berchmans typically experience in gym class.[5]

## Real classrooms use VR

### Clarkstown High School North

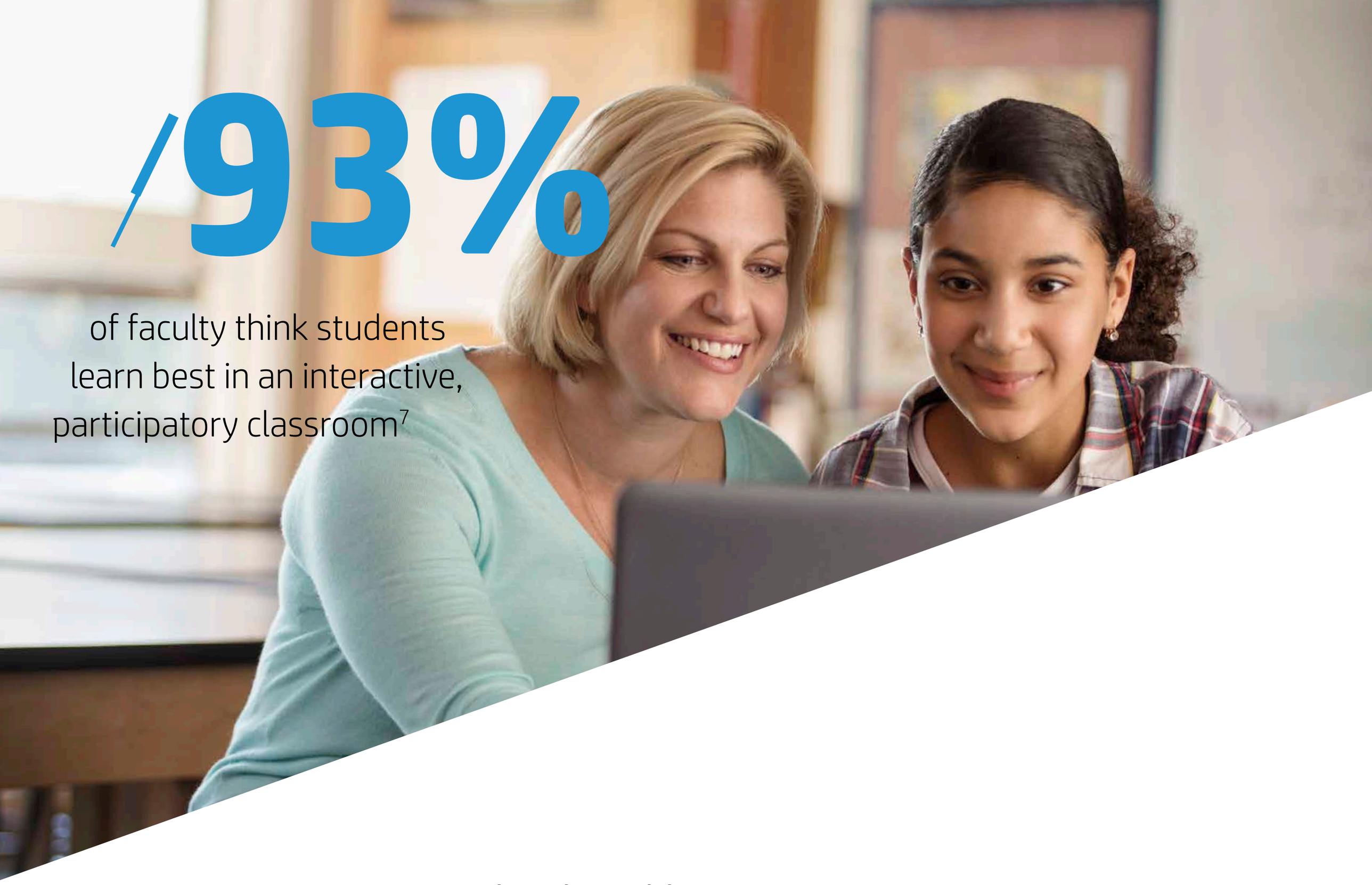
Heidi Bernasconi teaches biology and marine biology at Clarkstown High School North in New York. As a pilot program participant in Google Expeditions, she has helped develop 100-plus expeditions that can virtually send students under water to the Great Barrier Reef, out of Earth's atmosphere to the NASA space station or even into the human heart. For the one-time cost of a classroom kit, students are able to take multiple field trips that otherwise would have proved impossible in terms of cost, time, travel and physics.

### St. Kieran's Primary School

After a field trip to Clonmacnoise, primary school students at St. Kieran's in Ireland built 3D model replicas of the monastery using desktop computers with MissionV, a virtual reality platform. Students then used the Oculus Rift VR headset to view and interact with their replicas. *"They were solving problems, teaching each other,"* says Principal Esther Lambe. *"The kids don't realize this is all about education, it's all about history, it's all about project management and typing up reports and proper spelling. To them, it's fun."*[6]

What can your school do to make VR and AR a reality in the classroom? Find out

# 3.0 / REINVENT LEARNING




## Active, unstandardized learning

Devices are often criticized as enabling passive media consumption, but when used in a classroom setting for educational purposes, VR and AR actually can help children take an active role in the learning process.

It's one thing to present information to a student in a traditional, static manner; it's another for him or her to "experience" it in some way so that the information becomes more memorable and more real. One Stanford study found that 93 percent of faculty think students learn best in an interactive, participatory classroom, and 91 percent of students agreed.[7] Providing context for the information and engaging a class through interactive components helps them better understand the information when it is consumed and easily recall it later.

Additionally, VR and AR enable students to engage many of the competencies needed to approach complex challenges. Such skills include critical thinking about problem-solving, creativity, communication and collaboration. VR and AR also help students demonstrate curiosity and initiative, skills likely to prove vital for success in the digital economy after graduation.

*"We talk a lot about artificial intelligence, AI, but I think education is much more about IA, intelligence amplification,"* Dede says. *"We're always looking at technologies that can take what kids do well already and amplify their ability to do it better."*

Performance is important, and many VR and AR solutions let educators monitor student performance better than a traditional learning exercise would. Teachers are able to glean real-time data about which content is viewed, which exercises are completed and which are repeated, as well as a host of other pertinent information that can help teachers tailor instruction to the needs of each individual they serve.[8]

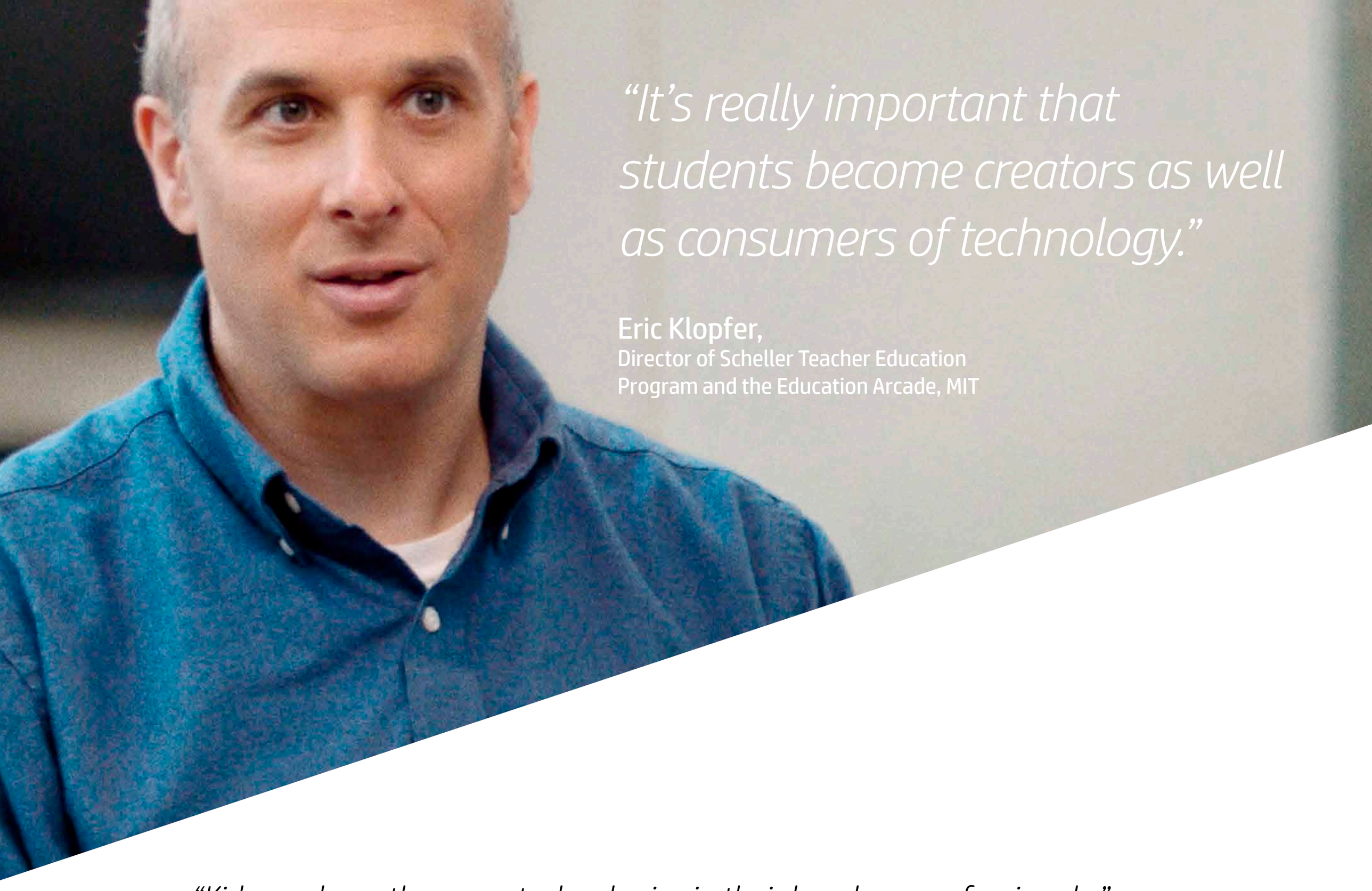

## Evolving skill sets and innovating education

Traditionally, instructors teach one subject at a time and introduce one new concept at a time. VR is such a rich medium, however, that students are able to grasp complex concepts across disciplines. This method facilitates an efficient teaching process and provides an effective learning experience.

*"We have to teach in chords rather than teaching in notes,"* Dede says. The "chords" he identifies as most prevalent in VR include subject matter expertise, scientific inquiry, critical thinking, collaboration, growth mindset, self-efficacy and complex causality.

With VR and AR, educators can incorporate interdisciplinary problem- and project-based learning, instead of teaching siloed subjects. This is similar to the philosophy behind STEAM (science, technology, engineering, the arts and mathematics) learning, which the New Media Consortium (NMC) and the Consortium for School Networking (CoSN) identify as the idea that all disciplines can and should relate to each other. Students see the big picture of how a wide variety of knowledge and skill sets tie together in the real world.[2]

Technology facilitates those kinds of learning environments. It also gives students—as early as primary school—access to the kinds of tools they'll be using in their professional lives.




*"Kids can have the same technologies in their hands as professionals,"* says Karen Cator, President and CEO of Digital Promise. She has seen firsthand the benefits of using VR in classrooms. *"When students were creating these VR stories, they were acting like professional filmmakers, and it was incredibly powerful."* Klopfer agrees, adding, *"It's really important that students become creators as well as consumers of technology."*

That shift, transforming students from content consumers to content creators, is paramount in engaging the learning process to its fullest potential.

In fact, study results from a third-grade classroom in Arkansas confirmed that student-led lesson planning positively impacted creativity, engagement and academic success.[9] After student-led lesson planning, these students were better able to understand key details in a story—with 83 percent success, versus 54 percent after instructor-determined teaching methods.

School performance is just one achievement indicator, however, and there's no telling how the use of technology will enrich each student's prospects. Consider how virtual field trips alone can expand children's worldviews within the confines of the classroom. VR enables virtual travel to places otherwise inaccessible to students and provides experiences likely unachievable until college or entrance into a specific career field.

# 4.0 / CHALLENGES CREATE A DIGITAL GAP


## For all students to be set up for success after graduation, administrators must lead the transformation to bridge the digital divide.

*"We're looking at the second-level digital divide,"* Cator says. *"The first digital divide is access. Do people have broadband access? Do they have access to a device? Second level is about use. What are people doing with these technologies? Many times, in lower-income schools, students are plugged into headphones, running through math problems, not engaged. The technology's running them; they're not running the technology."*

When she visits schools with more financial resources, though, there's a remarkable contrast. *"Students are working through challenges,"* Cator says. *"They're solving problems. They're using the technology to do research, to find experts, to crunch data. They are using the technology for their work."*

## What are the issues that create this digital gap?

### Barriers to access

- **Personal device cost:** Computers and mobile devices are a significant expense many families cannot afford. As these tools are essential to engage with VR and AR technologies, some students are limited in their ability to participate, or may have to share a device with a classmate.

- **Classroom device cost:** The necessary hardware is relatively expensive, and many schools are either unable or unwilling to pay for it. VR devices can be particularly costly, like many other emerging technologies.
  - While Google Expedition kits are still less expensive than an actual trip to the NASA space station, the cost falls outside the budgetary reality of many schools.

## Barriers to adoption and engagement

- **Lack of training:** Many teachers are unfamiliar with VR and AR, and may need additional training themselves before they can properly introduce these tools to students. This lack of knowledge requires an additional investment of time and money.
- **Teacher turnover:** Every year, instructors leave their posts for other teaching positions, alternative careers or retirement. Schools may be hesitant to invest in training teachers who might not be around long term.
  - Students from a low socioeconomic background and minority students are more likely to attend schools with inexperienced teachers and high staff turnover.[10]
- **Shortage of time:** Between planning instruction, teaching students, grading assignments and managing other responsibilities, educators are already stretched for time, thus making it difficult to devote additional hours to implementing new teaching tools.
- **Traditional methodologies:** Many administrators don't prioritize incorporating technology into the classroom simply because it wasn't part of their own educational experience.
- **Curriculum confusion:** While VR and AR technologies can help engage and inspire students, there isn't a general consensus of the potential and purpose in the education community about their most effective uses. Additionally, teachers don't have resources like VR and AR lesson plans on hand in order to integrate them easily into their curricula.

# 5.0 / HOW TO MAKE VR AND AR A REALITY

## What can schools do to make VR and AR a reality in their classrooms?

VR and AR engage students more deeply in subject matter and enable them to develop skills vital in the digital economy. When schools can provide these learning tools to students, they can inspire intellectual curiosity beyond the classroom.

Here are some steps your school can take to procure VR and AR tools and integrate them into the curriculum:

## Address barriers to access

1. **Purchase mobile devices for all students or for select classrooms.** The more tablets or laptops your school is able to provide, the more students are able to participate in AR activities at any given time.
2. **Partner with a business or organization to provide free or low-cost devices for classrooms.** Check with community centers, libraries, higher learning institutions and other groups that may cover or subsidize the cost of a device in exchange for positive public relations exposure.

3. **Purchase lower-cost VR devices for classrooms.** There are now increasingly budget-friendly VR systems, such as HTC Vive and the Oculus Rift.*
   - Google Cardboard headsets, which start at $15, are a less expensive option that allow students to mount a homemade VR system onto a mobile phone by using cardboard, hook-and-loop fasteners and rubber bands.
4. **Crowdfund VR or AR devices for a classroom.** Public school teachers in the United States can submit a classroom project on DonorsChoose.org, which enables private donors to contribute to specific classroom needs. Schools around the world can use a similar approach on Kickstarter.com for creative projects that require funding for VR or AR materials.

## Address barriers to adoption and engagement

1. **Invest in decreasing student-teacher ratios.** This approach is shown to reduce achievement gaps and improve educational outcomes for students from low socioeconomic backgrounds.[10] It also could help curtail teacher turnover, which makes investing in teacher training for tools like VR and AR more practical.
2. **Visit a school or class that has the kind of technology you're considering.** Do you want to provide free tablets for all students, or are you curious to see how a sixth-grade science class uses VR? Take a small group of your school's administrators and teachers to a nearby institution that offers the kind of technology and instruction you want to adopt.
3. **Seek VR and AR lesson plans from other schools.** Teachers across the world are incorporating these tools into their classrooms today. Search for online resources such as lesson plans and video tutorials about what's worked for them, or email a colleague who has experience in this area.

4. **Apply for grants for teacher training.** Many companies, universities and other organizations offer funding opportunities to educate teachers about using VR and incorporating it into their curriculum. Don't leave money on the table.
5. **Recruit outside of the box.** Contemplate hiring instructors with less teaching experience if they have excellent familiarity with digital tools and methods. Recent graduates may be particularly familiar with the latest technology.
6. **Recognize teachers who incorporate emerging technology in their classrooms.** Additional paid leave, stipends for training or even school-wide appreciation may encourage teachers to pursue these opportunities on their own initiatives.

Tip:

Present a range of solutions to all stakeholders and involve them in the decision-making process. Collaboration among school administrators, policymakers, teachers, parents, students and other interested parties in the community can help drive effective change that's sustainable in the long term.

# 6.0 / CONCLUSION

## Gear up for the future

Children who participate in VR and AR experiences today are likely to be those who create the technologies that transform our world tomorrow. Follow up high-tech encounters in the classroom with discussions that further encourage students to connect the training with its real-world applications.

As the digital age progresses, the role of a teacher is almost certainly going to shift.

A position that once required a subject matter expert to deliver facts for students to memorize is transforming into one that demands a digital-savvy mentor to facilitate learning opportunities to help children direct their own education. This approach encourages and empowers intellectual curiosity to serve students long after they've left the classroom, and administrators should keep this in mind as they make hiring decisions and allocate resources.

## Reinvent the classroom

In order to create the classroom of the future, schools must step beyond the familiar and move toward the promise of a reality they have yet to imagine. As the NMC/CoSN Horizon Report says: *"When educators are actively experimenting in the classroom, students in turn are more likely to confidently take risks themselves."* [10]

Two of the greatest learning tools at any scholar's disposal are formal instruction and life experience. VR and AR are able to merge the two in an innovative way that can elevate the entire education system.

Employ these powerful technologies in the classroom today. It may position your students to create possibilities for an entire civilization tomorrow.

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10. New Media Consortium (NMC)/The Consortium for School Networking (CoSN) Horizon Report, 2016 K–12 Edition, 2016.


* Important notice:
Students under the age of 13 should only use the technology under the direct supervision of a parent and/or teacher and in accordance with the manufacturer's user guide in order to reduce the risk of personal injury, discomfort, property damage, and other potential hazards and for important information related to students' health and safety when using the headset. Use should be limited per the needs of the individual user. The technology may require software, third-party applications, and/or minimum system requirements.