



Right Device for Learning & Teaching

Analyst Report | Commissioned by Intel[®]

The Right Device for Learning and Teaching

With increasingly ubiquitous technology in schools, students and teachers are discovering the transformative power of connected devices to improve student outcomes. Modernized IT infrastructure enables anytime, anywhere learning by syncing learning data between the cloud and devices. Access to seemingly limitless online resources and real-time analytics has begun to make personalized learning a reality. Increased opportunities for collaboration and creative expression lead to more relevant, meaningful learning experiences. This type of technology-enhanced learning environment ensures that all students are better prepared for college, career, and life.

Yet, these benefits don't appear automatically. Without a well-defined vision, thorough planning, and ongoing teacher professional learning, technology integrations can just as easily fail. The critical decision about which devices to put in the hands of students and teachers is one key to success. Some devices—while they may be popular in the consumer market—are not a good fit for education.

Only the right devices will improve how teachers teach and students learn. So, which devices are the right devices for education? This paper will explore the primary considerations educational leaders need to take into account before making this critical decision.

(intel)

360° LEARNING EXPERIENCE

The Right Technology Gets You There

Intel's holistic approach to devices is part of their "360° Learning" vision of "learning without limits." The right devices alongside a strategic plan, robust IT infrastructure, and trained teachers empower students to go wherever their learning takes them.



EXPERIENCES

Greater student engagement with meaningful experiences and enhanced technology

Greater teaching experience with greater connectivity, assessment tools and data insights

Learn more at Intel.com/education.



U.S. EDUCATION TECHNOLOGY: A MATURE ECOSYSTEM

In 2016, 12.6 million devices were shipped to U.S. schools.¹ That's close to one new device for every four of the approximately 55 million students enrolled in public and private K-12 schools in just one year.² No longer is technology taught as a discrete subject area in computer labs. Now, it's a fully integrated component of everyday teaching and learning and a non-negotiable fixture of the modern classroom.

As a result, the conversation has transitioned beyond how we can ensure that every student has access to technology. Educators are now tasked with finding ways to ensure that every student has **access to use technology in meaningful ways** to enhance and personalize their learning.

MORE CHOICE

With this mature ecosystem comes an increasingly complex landscape for decision-makers to navigate, one filled with consequential choices that can make or break a technology implementation.

Less than 10 years ago, educators were limited to a choice between computers running one of two operating systems: Microsoft[®] Windows[®] and Apple[®] MacOS[®]. In 2010, Apple iPads running Apple iOS[®] turned education upside down with a tablet form factor ideal for mobile learning. A robust app store with an app for almost every purpose gave credence to the idea that classroom technology can help personalize learning. The refined touchscreens unleashed creativity and made learning with devices intuitive, even for the youngest students.

Education did not have to wait long for yet another disruptive influence: Google® Chromebooks. Built on Chrome OS[™], these budget-friendly devices seemed purpose-built for education, syncing student data to Google Drive[™] and powering learning with Google's web-based suite of collaborative tools. Simplified IT processes enable even the smallest IT staff to deploy and manage thousands of devices across multiple school sites. In just a few of years, Chromebooks quickly rose to the top of U.S. educational sales. In 2016, they represented 58% of devices shipped to U.S. schools.³ Moreover, Chromebooks are not standing still: updates to the software as well as touch-enabled devices with evolving form factors that support Android[™] apps from the Google Play[™] store are the latest in a series of improvements, making Chromebooks even more accessible to students.

2 https://nces.ed.gov/fastfacts/display.asp?id=372



Apple[®] starts its Kids Can't Wait campaign and donates 9,000 Apple II's to the California schools



1985

The Oregon Trail teaches students history through a video game



1989 (

Word, designed for use with a mouse, is released for Windows*

WHAT ABOUT MAC OS?



Apple MacBooks continue to be a popular choice for teacher devices. With easy usability and high-powered Intel[®] Core[™] processors they meet the productivity needs of busy teachers. However, for most schools facing tight budget considerations, MacBooks are generally not a realistic choice for student devices.

¹ http://www.futuresource-consulting.com/Press-K-12-Education-Market-Qtr4-0317.html

³ http://www.futuresource-consulting.com/Press-K-12-Education-Market-Qtr4-0317.html

RIGHT DEVICE FOR LEARNING AND TEACHING



The challenge from iOS and Chrome OS has forced Microsoft to reimagine its education offerings. In 2015, Microsoft released Windows 10: one operating system for all devices, from desktops to laptops to tablets. While maintaining its existing advantages like the ability to install full versions of professional software, Windows 10 added the advantages of new form factors and natural touch usability. At the same time, Windows 10 granted students and teachers access to the tools of others (i.e., G Suite for Education) alongside their own compelling education-focused solutions like OneNote[®] Class Notebooks, Digital Inking for Windows, and Office 365. Now, Windows 10 S promises to simplify device management and improve performance and battery life for more budget-friendly Windows devices.

A KEY DECISION

In this rapidly evolving environment, each operating system comes with its own set of advantages and constraints. In addition to choosing between iOS, Chrome OS, and Windows, decision-makers have to pick between a wide variety of device form factors. Laptops, 2-in-1s, and tablets promote different approaches to learning and teaching with technology in the classroom. Additionally, decision-makers can't ignore the importance of what powers student and teacher devices. The device hardware, including the processor, helps determine the impact of student and teacher devices on learning.

In order to make the correct choice about which device or devices are the best for their own unique situations, decision-makers should consider the following questions:

- 1. How will the devices impact student learning and classroom pedagogy?
- 2. How will the devices be deployed and managed?
- 3. What is the "real" cost of the new devices?

Only by working through the elements of each of these questions can schools ensure they choose future-ready devices that accommodate all possible learning and teaching use cases, the requirements of IT staff, the school's infrastructure, and budget sustainability.



SMAR

1991

SMART releases its first interactive whiteboard



8% of U.S. classrooms have Internet access



1997

PalmPilots, an early Personal Digital Assistant (PDA), introduce the concept of 1:1 technology to education



RIGHT DEVICE FOR LEARNING AND TEACHING

LEARNING PEDAGOGY

Successful technology implementations begin with a clear vision for how students and teachers will use the devices to enhance learning. The fact is that some devices better support district goals than others. By first defining exactly what students and teachers need to be able to do, decision-makers can better select devices that help them achieve their goals.

Digital-Age Pedagogies

Districts often start by identifying the instructional models they want to implement and support in the classroom. Educators in the 2016 CoSN IT survey—recognizing that learning can happen anytime and anywhere—identified mobile learning as their top priority.⁴ Other districts tout the benefits of personalized learning. Teachers use active learning strategies to individualize learning paths and ask students to do more than simply consume media. Instead, students are required to interact with content, collaborate with others, and create their own artifacts of learning. A growing number of schools are prioritizing a Maker culture, encouraging students to create from scratch with their hands and their devices. In order to activate their new pedagogical priorities, the right device is essential. Flexible and more powerful devices, like laptops or 2-in-1s, can meet variable demands. These devices, with fluid and intuitive usability, support all students' learning styles with multiple input options, including keyboard, touch or stylus.

Full Range of Student and Teacher Activities

Educators should ensure that the devices they select support the full range of student and teacher activities in their usage models. For some, especially in the younger grades, tablets like iPads may be a smart choice. With a large library of apps, tablets can be ideal for engaging students in hands-on activities and developing foundational skills in literacy and mathematics. However, consumer tablets were not designed to compete against the full range of tasks that can be accomplished on a PC. Often, apps can fall short of full desktop applications, and student productivity may be hampered without an integrated keyboard.

For schools that predominantly rely on Google software, Chromebooks can accommodate more usage models. Tight integration of G Suite apps enhanced by real-time collaboration meet the vast majority of student productivity needs. Further, new form factors and an ever-expanding list of web (and now Android) apps increase Chromebook[™] utility.

However, for higher productivity and career and technical education usage models, students may well need a fully-featured operating system like Windows 10 alongside more processing power, memory and storage. If districts use Office 365 or want to develop career professional skills with Autodesk[®] AutoCAD[®] or applications from the Adobe[®] Creative Cloud[®], Chromebooks are not a viable option. Fully-featured Windows 10 computers remain the only devices that support the full range of student activities.

4 http://www.cosn.org/sites/default/files/CoSN_ITLdrship_Report_2017_040317.pdf



2001

Wikipedia® provides a quick answer to practically any query

elicker

Clickers promise to make lectures more engaging



) 2004

Sal Kahn tutors his cousin in math over the Internet with Yahoo[®] Doodle Images

Clarity Innovations

RIGHT DEVICE FOR LEARNING AND TEACHING

The diverse needs of students across the grade levels is one reason that districts often choose more than one device. For grade levels with simpler usage requirements, districts can get by with a more basic device. For students in higher grade levels with more diverse and complex needs, districts will need to consider a more powerful choice.

Digital Content and Resources

Educators also need to choose devices that accommodate all the digital content and resources students and teachers will need for learning. A past priority for schools was ensuring compatibility with legacy digital content. While it is still worth considering whether new devices can access Flash® content, decision-makers should shift their focus to ensuring that new devices are ready for the digital content of the future. For example, as Google makes the shift from Chrome apps to Android apps, Chromebooks just one or two years old are already outdated. What's more, in order to fully take advantage of Android apps, Chromebooks should be equipped with sufficient storage, convertible form factors, touch screens and possibly even a stylus.

Essential Classroom Workflows

Decision-makers must also consider specific workflows of the digital classroom, such as the ability to handle multiple users per device. Even as other operating systems have made improvements to how new users sign-in and sync their learning data, Chromebooks still have the simplest solution and essentially make which device students use a non-issue. Another daily classroom requirement is the ability to project teacher and student screens. Solutions like Intel Unite[®] enable teachers to simply mirror their devices to screens and run secure meetings about sensitive student data without the wires.

Future-Proofing for the Cloud

The impact of the cloud should not be lost on decision-makers. More and more of student and teacher work is stored in the cloud, whether in iCloud[®], Google Drive, Microsoft OneDrive[®], or third party tools like Dropbox. Further, an increasing amount of content and applications are run through the web, and schools are even virtualizing applications through cloud services like Amazon Web Services[®] or Azure[®]. The move to the cloud demands that devices have the right mix of hardware, including the latest wireless and Bluetooth, to help devices run faster and maintain connectivity.

Online/Offline Functionality

So much of what students and teachers do on devices is accomplished in the cloud. However, even though connectivity in schools has come a long way, it is premature to think that offline functionality no longer needs to be a consideration. Google has made strides in improving the offline capabilities of G Suite Apps and offline Android apps are a welcome addition, but Chromebooks remain internet-dependent. With access to Internet outside of school being far from a certainty for all students, schools would be smart to ensure that new devices display full offline functionality. Further, whether purchasing iPads, Chromebooks, or Windows 10 devices, educators can future-ready devices by purchasing above-the-minimum internal storage.



94% of U.S. classrooms have Internet access

Google

Google purchases Writely and the idea that will become Google Apps for Education is born

1 Q → ×

2007

XO computers attempt to make one computer for every student an affordable possibility on a global scale



DEVICE MANAGEMENT

No matter the size of the deployment or the size of the school district, decision-makers need to consider how the new devices will be deployed, managed, and maintained. Not only is this a significant consideration for IT costs and staffing; it is essential to the smooth operation of the new devices by students and teachers. Further, student data privacy and security concerns escalate as students spend more time learning with technology. Historically, schools exerted both substantial time and money to image and reimage devices, install and update software and hardware, and enforce security protocols across a fleet of devices. The key to success in the modern environment is finding ways to reduce these costs and complexities.

Tablets, often with their origins in the consumer market, were not necessarily meant to be deployed to large school districts. In order to enforce the same policies and install the same apps on tablets, school districts generally use a third-party Mobile Device Management (MDM) service to enroll and manage devices. Not only does this add extra costs, but it also requires an additional IT skillset. This creates a more complex and costly set of deployment and management protocols, especially in large-scale deployments.

More purpose-built for education, Chromebooks have simplified device management. Chromebooks can be deployed en masse from the admin console after paying a life-of-thedevice management fee of thirty dollars. Through the admin console, IT staff can not only manage apps and setting on devices; they can also manage users. However, with Google's ease of management comes a handful of concerns about student data privacy. The Electronic Frontier Foundation (EFF) continues to push Google to be more specific about steps it takes to protect student data.⁵

Microsoft recently released a new version of Windows, Windows 10 S, to compete against Chrome OS. This version, targeted at education, is "streamlined for simplicity, security and speed."⁶ Beyond improving performance for students, Microsoft is also simplifying deployment and management for education. IT staff can quickly set up machines with a USB drive, and Intune for Education[®] makes managing devices accessible to individual teachers. While Windows 10 S limits devices to apps available from the Windows Store, school districts can easily upgrade to the full version of Windows 10 if they find this limiting.

5 https://www.eff.org/wp/school-issued-devices-and-student-privacy

€t∨ 2007

The first addition of Apple TVs ship



2007

Netbooks provide a lightweight and lowcost option



⁶ https://www.theguardian.com/technology/2017/may/03/windows-10-s-microsoft-faster-pc-comparison



	IOS	CHROME	WIN 10
Supports full-range of student learning tasks	0		
Provides full offline functionality			
Supports full versions of career-ready applications	0	0	
Simplifies management processes		٠	
Accommodates multiple users per device			
Supports legacy and future digital content and resources			
Range of form factors to support variable student needs	0	٠	
Provides unlimited cloud storage for education	0	٠	

 \bigcirc = No \blacksquare = Somewhat \bigcirc = Yes

REAL COST OF DEVICES

Because the device purchase price is paid as an upfront cost, it can be tempting to overemphasize its importance. However, other costs can accumulate over the life of a deployment, and infrastructure and IT support should not be ignored during the planning process.

Purchase price

Purchasing costs vary widely. Base Chromebooks and Windows 10 education devices can cost less than \$200. Yet a budget device with a budget processor will most likely deliver poor value, limiting its utility in the classroom. The old adage "You get what you pay for" holds true for the classroom. Paying the extra money for a better device with a better processor can increase the long-term value in terms of outcomes and satisfaction, especially for grade levels with higher productivity requirements.

Digital content and resources

Some content, like the apps in G Suite for Education, are free with unlimited storage in education, but others, like many apps in app stores or installed software packages, come at a significant cost. Schools can save money by adopting devices that accommodate existing software licenses and digital content.

Peripherals and infrastructure

Investments like upgrades to network infrastructure are often mandatory for all device deployments, and necessary peripheral investment can depend on the chosen device. For example, some devices require purchasing accessories like keyboards, styluses, dongles or adapters. Schools choosing devices with limited internal storage may need to purchase extra storage solutions. Additionally, the cost of hardware and software for classroom projection and screen sharing will need to be included.

Britannica

2010

Encyclopedia Britannica® publishes its last print version



Acer[®] and Samsung[®] release the first Chromebooks





Management and maintenance

The cost to deploy, manage, and maintain devices can quickly add up. Schools adopting iPads will likely need to include the cost of an MDM. Additionally, complex management processes may require a larger IT staff. Cheaply built devices, not designed for rigors of the classroom, will be more prone to failure. Broken screens, dead batteries, and ruined ports can quickly reduce the number of devices available for learning. It is also worth noting how quickly a device becomes obsolete. For instance, Google stops supporting and automatically updating Chromebooks five years after their release date (not their purchase date).

Professional learning

Educator professional learning is essential to successful technology integrations, and the cost in terms of both time and money should be calculated into total costs and timelines. However, if teachers are already familiar with the chosen device type, operating system, and applications, professional learning costs can be minimized.

The overall real costs incurred by the school are only the first half of the equation. When creating a longterm plan based on a sustainable budget, decision-makers also need to consider the value that their technology investments create for end-users, both students and teachers. Only when new devices improve learning outcomes in the classroom have districts found real value and made smart investments.

CHOOSE THE RIGHT PROCESSOR

What's inside a device matters. The processor has a dramatic impact on performance of a device in the classroom. Leading third party benchmarks, like CrXPRT and SYSmark, showcase the system advantages achieved by Intel processors over ARM-based competitors from companies like Rockchip[®], AMD[®] and MediaTek[®], regardless if they are inside of Chromebooks or Windows 10 devices. Prowess Consulting[®] and Principled Technologies[®], two independent technology research companies, have conducted research studies examining the learning differentiators between Intel-powered devices and ARM-based alternatives.

Intel's processor stack includes processors for every type of device, from budget, power-efficient Chromebooks to high-end Windows desktops, and with each new generation, performance improves. Schools that can afford to spend more for a better processor will find additional value.





CONCLUSION

In this complex and ever-changing ecosystem, there is no one "right" device for teaching and learning. Instead, decision-makers must balance their own answers to the three questions:

- 1. How will the devices impact student learning and classroom pedagogy?
- 2. How will the devices be deployed and managed?
- 3. What is the "real" cost of the new devices?

Schools districts must choose the devices that meet most needs of students and teachers, can be easily deployed and managed, and fit within the available budget. School districts have to find the balance between pedagogy, management, and cost—the intersection of the three circles in the figure below.



The right devices meet district learning goals, are easily managed, and deliver true value.

School districts on a tight budget are challenged with a smaller "sweet spot." The best bet for most of these schools will likely be Chromebooks, powered by a reliable Intel processor. Budget-friendly devices running Windows 10 S may soon be a realistic solution, depending on the results of early adopters. For now, the tight integration of Chromebooks with G Suite for Education services creates a productive learning platform; easy management keeps IT costs down; and decision-makers have plenty of choice—even below a price point of \$300. Purchasing newer models (late 2016 or later) will future-proof devices by guaranteeing access to Android apps.

With a larger budget, school districts will have a larger center of the Venn diagram and a greater number of devices to choose from. These districts should consider more versatile Windows 10 devices with more powerful Intel processors, like Intel Core processors, especially for students and teachers with more complex usage requirements. Full-powered laptops remove all limits to what can happen in the classroom with technology. In addition to being able to do everything a Chromebook can do, Windows 10 devices, with a powerful processor, can run professional-grade software and display full offline functionality. While purchase and IT costs may be higher, the value a district can derive from the more full-featured devices can be transformative.



Microsoft releases Windows 10, one device for all device form factors

2016 Chromebook

sales rise to be the most-shipped device in the U.S.

2017 & BEYOND

What does the future hold for education technology?



DEVICE FORM CONSIDERATIONS

Form Factors



Tablets

While perfect for some learning activities, the lack of a keyboard or a desktop ecosystem limit their use cases in education.



Convertible laptops

with 360° hinges, or

detachable screens.

the design can prove

Educators should ensure

durable in the classroom.

transform into tablets

2-in-1s



Laptops

Laptops, with their time-tested mobile-first design, remain the most ideal form factor for education. New advances such as the integration of touch and styluses increase their flexibility.



Desktops

Still the smart choice for stationary workstations in computer labs and media centers, desktops bring power for professional-grade design applications.



All-in-Ones

For a slightly more mobile, yet still powerheavy experience, All-in-Ones frequently include touch and can be transported when needed.



Memory

The more RAM, the better a device handles multi-tasking 4 GB recommended.

Storage

Sufficient internal storage helps with working offline 32 GB recommended.

Processor

Intel processors feature better performance and reliability than others.

Ruggedization Touch Cameras Keyboard Ports Stylus

Purpose-built devices with Corning[®] Gorilla[®] Glass screens, rubberized corners, and spill-resistant keyboards will help increase device longevity.

Touch integration makes device usability seamless and intuitive, especially for students in the younger grades.

Most devices have a front-facing camera for video conferencing, but a rear-facing camera can enhance usability, specifically in content creation.

Integrated, full-size keyboards are more reliable than bluetooth connected keyboards.

A variety of port types will eliminate the need for dongles and adapters. New port types, such as USB-C and Thunderbolt ports, can improve performance and future-proof devices.

Digital inking with a stylus continues to create and extend opportunities to do with technology what could previously only be done on paper.



Clarity Innovations

Our mission is to help improve the practice and process of teaching and learning through effective use of promising technologies.

Steve Burt, Director of Strategy



Steve has worked for Clarity Innovations since 2002 and is currently the Director of Strategy. He oversees the development of new solutions for Clarity's clients. This process typically involves blending research-based practices with emerging technologies. He's paying a lot of attention right now to the education potential of emerging ecosystems as well as how changes in digital publishing are affecting teaching and learning in the classroom. Having worked with educators and students for nearly two decades, Steve is skilled in understanding a wide variety of technologies and their application in education.

Tod Johnston, Content Developer



Tod's decade of classroom teaching gives him vital, in-the-trenches education expertise. In his most recent teaching assignment, he piloted a 1:1 classroom and saw first-hand the true potential of technology in the hands of students. Now, Tod draws on his teaching experience to create content that helps schools and educators effectively use technology to enhance learning. As a member of Clarity's content team, Tod uses his strengths as a writer to author instructional materials: including both online and face-to-face professional learning courses for educators and student-facing curriculum.

CONTACT US

Write, call, email, or stop by in person, whether you're interested in:

- · More information about our background and qualifications;
- · A meeting to discuss a potential project;
- A brief primer on promising technologies for education; or,
- Our thoughts on a few concepts or ideas you may have.

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