Google in Education: Is More Ever Enough?

Commissioned by Intel® Education

For Internal Training Only
Executive Summary

Google's movement into the education market is reminiscent of the Japanese automakers' entry into the U.S. market in the 1970s. Introduced as low-cost, low-frills alternatives, both were initially ridiculed by critics as offering underpowered "toys" that couldn't compete with the beefier horsepower offered by the well-established market leaders. Both built upon humble beginnings by taking their lumps, continuing to invest, and by finding unique ways to provide value to their customers. And both eventually developed disruptive new approaches that redefined their respective industries.

With the announcement in Q3 of 2014 that US education market Chromebook unit sales have surpassed the iPad, Google is on a path to take over the K-12 market: that's zero to over 25% market segment share in two years, competing quietly and organically against titans Apple and Microsoft. In the U.S., sales of Chromebooks with Intel architecture have gone from a single digit position in 2013 to near 80% market segment share as of late 2014. At the same time, since its introduction in 2006, Google Apps for Education has grown its user base to more than 40 million users worldwide, offering an easily managed, web-based suite of tools that supports all major platforms. Once mocked as a dilettante effort in productivity applications, Google's free productivity apps Docs, Sheets, and Slides now pose a major threat to Microsoft Office.

In addition to Google's core operating systems and device offerings, the company is "dabbling" in a wide array of offerings for the education marketplace, seemingly with minimal regard for short-term return on investment including an ever-expanding list of Chrome and Android operating system versions and devices, a growing set of tools and features in the Apps for Education suite, a widening range of largely free management tools (including LMS features via the just introduced Google Classroom), textbook distribution via Google Play for Education, and much more.

Although many users view Google's efforts as altruistic and in line with their "don't be evil" corporate motto, it seems more likely that Google is taking a page from Apple's early playbook by becoming a well-integrated part of K-12 students lives — an investment that they believe will lead to their continued loyalty as the consumers, employees, and business owners of the future.

This report examines four core areas of Google's effort in K-12 Education including:

1. Infrastructure efforts including operating systems, hardware, and software;
2. Instructional materials and educator professional development;
3. Device, user, and account management; and,
4. Strategies to support leaders and school policy.

In addition, the report includes a number of case studies of schools and districts that have implemented large deployments of Google-based devices.

1 Financial Times and International Data Corporation (IDC), Dec 1, 2014
2 https://www.google.com/edu/trust/
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Infrastructure: Operating Systems, Hardware and Software

Google's evolving strategy in operating systems is potentially one of its most impactful long-term business moves. Having achieved market share dominance with an app-based smartphone-style OS (Android), Google subsequently introduced an Internet-dependent cloud OS where everything is a Web app (Chrome OS). And most recently, with the introduction of Chrome Apps, the company has opened the door to becoming a new de facto OS via the Chrome browser running on Windows, Macintosh, iOS and other platforms.

Although extremely successful in the consumer space, Android tablets have seen relatively slow adoption in U.S. schools. However, given Google's likely plans to merge Android and Chrome OS, this will likely become a moot point. In 2009, Sergey Brin specifically referred to the company's eventual convergence of the two systems⁴, and while nothing has been officially announced, continued developments point to its likelihood. For example, in the past year, Chrome OS gained support to run Android apps, and Lollipop's new apps allow Chrome's browser tabs to show up like individual apps.

In what several analysts have referred to as a “Trojan horse,” Google's introduction of packaged apps available through the Chrome browser may be one of its most revolutionary moves to date. The Chrome browser is now used by more than 40% of internet users on all major platforms, and by way of the Chrome browser, Google is essentially putting its own app ecosystem right on top of Windows and OS X. “We want to make Chrome OS a full-fledged operating system,” according to Brian Rakowski, a Chrome VP.⁵

“At the end of the day, developers have a choice — do I build a web app, do I build a native app, or do I build a Chrome App?” stated Rahul Roy-Chowdhury, a project manager overseeing Chrome Apps. “Building a different version of your app for each individual operating system takes time and gets expensive. So our hope is that, if you want to be on every platform, you'll build a Chrome App because eventually, you'll be able to run Chrome Apps everywhere.”⁶

“. . . with the introduction of Chrome Apps, the company has opened the door to becoming a new de facto OS . . .”

Given their rapid adoption of Chromebooks, schools are some of the first to begin using the growing collection of available Chrome apps. Of course, critics are quick to point out that it's going to be difficult for developers to deliver the kind of heavy-duty, enterprise-level applications that business and industry users need. However, starting with the September 2014 introduction of a streaming version of Photoshop⁷ designed to run straight from the cloud to Chromebooks, that argument may quickly fall by the wayside. Ironically, schools — who have typically been late adopters when it comes to technology — may be leading the way into a new paradigm of computing.

⁵ http://www.theverge.com/2013/9/5/4696618/google-chrome-apps-chrome-os-windows-os-x-blink
⁶ http://www.theverge.com/2013/9/5/4696618/google-chrome-apps-chrome-os-windows-os-x-blink
HARDWARE

Chromebooks and the Chrome OS

Chromebooks are cloud-based research, collaboration, and productivity devices that offer schools an “instant-on” ecosystem, a variety of powerful apps, long battery life, simple IT management, and automatic updates. They don’t yet, however, offer a complete offline solution nor support specialty Windows* and Mac* software, or work with interactive whiteboard software (but packaged apps and streaming apps like the new Photoshop are quickly moving in that direction).

Chromebooks are an affordable, streamlined way for students to conduct meaningful research, create light yet compelling content, and collaborate with peers or teachers almost anywhere. With Chrome-friendly apps and tools such as Google Classroom — where teachers can create and collect assignments paperlessly and provide direct, real-time feedback and grades — teachers can facilitate responsive and engaging 21st Century learning, as well as securely administer student assessments. Meanwhile, IT administrators can simplify deployment, management, and security.

The Google Chrome OS is a lightweight operating system (OS) that was initially intended primarily for netbooks or tablet PCs. Google announced Chrome OS in July 2009, and shortly thereafter released the open source version, Chromium OS. The operating system is built on top of a Linux kernel and runs on Intel x86 and ARM chips. Google partners with original equipment manufacturers (OEMs) including Samsung, Hewlett-Packard, Lenovo and Intel to manufacture hardware devices capable of using the OS.

Schools that choose Chromebooks generally do so for their low cost, minimal IT support, required easy administrative control, and strong tools for collaboration. Other considerations include:

· Simple user experience
· Low IT overhead and maintenance
· Powerful administrative control
· Cloud-based: easy collaboration between students, teachers, and administrators
· Student accounts sync between machines: no lost work or interrupted workflows
· Seamless integration with Google Drive
· Low cost of ownership and replacement
· Near-instantaneous boot (less time wasted in class)
· Automatically updated boot; very little technical assistance needed
· Never obsolete
· Easily configured
· Capable of replacing computer labs & carts

7 http://chrome.blogspot.com/2014/09/adobe-joins-chromebook-party-starting.html
· Reported battery life** exceeds usage in a school day
· HDMI-, USB-, VGA- and Bluetooth-compatible models integrate with classroom projectors and other peripherals

The core strengths of Chromebooks have also been its weakness:
· Limited file and application support
· Not a popular choice as a teacher’s primary laptop
· Schools often retain competitor solutions for gaps in Chromebook capabilities
· Incompatible with SMART Boards* (although capable of projection and mirroring)
· IT specialists at schools are often unfamiliar with cloud-based systems
· Best classroom uses require third-party applications
· Inadequate for most WiDi setups

As a primarily app-based tool, Chromebooks currently rely on the increased sophistication and volume of Web-based applications. Chromebooks’ continued success requires developers to create Chrome-friendly, Web-based solutions for education, which in turn depends on several pressures (e.g., critical mass of users or appropriate cost-benefit margins) including:

· Network investment: any district considering Chromebooks must invest in network management and infrastructure

· Network dependency: network failures often cripple a Chromebooks school
Leading Chromebook Devices in Education

The following devices provide an overview of leading Chromebooks currently in the education market.

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>ACER C720 CHROMEBOOK</th>
<th>SAMSUNG CHROMEBOOK</th>
<th>HP CHROMEBOOK 11</th>
<th>HP CHROMEBOOK 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen</td>
<td>11.6&quot; (1366x768) display, 16:9 aspect ratio</td>
<td>11.6&quot; (1366x768) display</td>
<td>11.6&quot; (1366x768) display, 16:9 aspect ratio Application Processor</td>
<td>14&quot; display with 16:9 aspect ratio</td>
</tr>
<tr>
<td>Processor</td>
<td>Intel Celeron, 1.1 GHz</td>
<td>Samsung Exynos 5 Dual Processor</td>
<td>Samsung Exynos 5 Dual (5250)</td>
<td>Intel® Dual-Core Celeron™ processor, 1.1 GHz</td>
</tr>
<tr>
<td>Storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
</tr>
<tr>
<td>Dimensions</td>
<td>0.75 inches thin – 2.76 lbs/ 1.25kg</td>
<td>0.7 inches thin – 2.42 lbs / 1.1 kg</td>
<td>297 x 192 x 17.6 mm/2.3lb / 1.04kg</td>
<td>0.81 inches thin – 4.08 lbs / 1.85 kg</td>
</tr>
<tr>
<td>Battery Life</td>
<td>8.5 hours</td>
<td>6.5 hours</td>
<td>6 hours</td>
<td>9.5 hours</td>
</tr>
<tr>
<td>Price</td>
<td>$199</td>
<td>$249</td>
<td>$279</td>
<td>$299</td>
</tr>
</tbody>
</table>
## Device Configuration

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>ACER C720 CHROMEBOOK</th>
<th>SAMSUNG CHROMEBOOK</th>
<th>HP CHROMEBOOK 11</th>
<th>HP CHROMEBOOK 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classroom Usage</td>
<td>Redesigned with a thinner and lighter chassis, along with long battery life: all at an affordable, school-friendly price. Intel chip allows multiple tabs and impressive processing power, more than the ARM-based Chromebook (as well as better peripheral support). For schools that need more power and functionality than a mobile tablet, but less cost and complexity than a full-fledged PC, then the C720 Chromebook is a good fit.</td>
<td>Focuses on the core concerns of administrators — cost and battery life. Its ARM processor has advantages (no fans, low power consumption) and disadvantages (slower performance). The success of the Samsung Chromebook in education demonstrates the initial priorities of schools when choosing a Chromebook: battery life over performance or peripherals.</td>
<td>A bold addition to the low-cost Chromebook line, boasting a sharp, Mac-ish design, comfortable keyboard, long battery life, bright display with a light and thin chassis. For schools that need more power, functionality and flexibility though, the HP Chromebook 11 — due to its ARM processor — will often prove sluggish or limited, especially in terms of externals. The model was initially recalled due to power cord danger.</td>
<td>The HP Chromebook 14 features powerful processing performance: Web pages load quickly and switching between tabs is satisfyingly swift. The laptop promises up to 9.5 hours of active use, which is an impressive, school-friendly amount of time for a laptop this size to stay alive. The HP Chromebook 11 boasts a better display, design and build quality among low-cost Chromebooks, but the Chromebook 14 delivers stepped-up performance and expanded connectivity options.</td>
</tr>
<tr>
<td>DEVICE</td>
<td>ACER C720P CHROMEBOOK</td>
<td>TOSHIBA CHROMEBOOK 2</td>
<td>ASUS CHROMEBOOK C200</td>
<td>ACER CHROMEBOOK 13</td>
</tr>
<tr>
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</tr>
<tr>
<td>Screen</td>
<td>11.6” (1366x768) touchscreen display, 16:9 aspect ratio</td>
<td>13.3” (1366x768) display, 16:9 aspect ratio</td>
<td>11.6” (1366x768) display</td>
<td>13.3” (1366x768) display</td>
</tr>
<tr>
<td>Processor</td>
<td>Intel® Dual-Core Celeron™ processor, 1.1 GHz</td>
<td>Intel® Dual-Core Celeron™ processor, 1.1 GHz</td>
<td>Intel® Dual-Core Celeron™ processor, 2.6 GHz</td>
<td>2.1 GHz Nvidia Tegra</td>
</tr>
<tr>
<td>Storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
</tr>
<tr>
<td>Dimensions</td>
<td>0.78 inches thin – 2.97 lbs/1.35kg</td>
<td>0.8 inches thin and 3.3 lbs / 1.5 kg</td>
<td>0.8 inches thin and 2.5 lbs / 1.13 kg</td>
<td>0.7 inches thin and 3.31 lbs.</td>
</tr>
<tr>
<td>Battery Life</td>
<td>7.5 hours</td>
<td>9 hours</td>
<td>11.5 hours</td>
<td>13 hours</td>
</tr>
<tr>
<td>Price</td>
<td>$299</td>
<td>$279</td>
<td>$249</td>
<td>$279</td>
</tr>
<tr>
<td>DEVICE</td>
<td>ACER C720P CHROMEBOOK</td>
<td>TOSHIBA CHROMEBOOK 2</td>
<td>ASUS CHROMEBOOK C200</td>
<td>ACER CHROMEBOOK 13</td>
</tr>
<tr>
<td>--------</td>
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</tr>
<tr>
<td><strong>Classroom Usage</strong></td>
<td>The Acer C720P Chromebook offers touchscreen functionality (allowing the use of educational apps) in addition to the standard Chrome-based design: all for a remarkably low price. Combine that with fast and responsive Intel processing power, long battery life and surprisingly attractive design, the Acer C720P opens up a lot of opportunity in the education space.</td>
<td>The Toshiba Chromebook features a responsive full-sized keyboard and touchpad, along with a large, bright screen which should appeal to students and support creative projects. HDMI and two USB ports allow for decent peripheral support &amp; classroom connectivity. With a no-nonsense design, Intel Celeron processing power, long school-friendly battery life and affordability, the Toshiba Chromebook could become a powerful player in the Chromebook space.</td>
<td>Praised for its stellar battery life (11 or so hours of continuous on a single charge), this student-oriented device also boasts respectable power, affordability and mobility: making it a great device for school-wide collaboration both in and out of the classroom. A textured surface also helps keep it safe in little hands when traveling between classes. The screen, however, seems a little &quot;washed out.&quot;</td>
<td>Despite its under-performing ARM processor, the Acer Chromebook 13 features a sleek design and user-friendly utility while providing solid battery life: more than enough to keep up with students straying beyond the power outlets of classroom. Still, it feels a little heavier than expected, and — while having a large screen — the image seems grainy, which could hinder learning with students who have vision difficulties. Multi-tasking and single-tab browsing are above average. Chromecasting and full-screen video work well, helping teachers to make more effective presentations.</td>
</tr>
<tr>
<td>DEVICE</td>
<td>ASUS CHROMEBOOK C300</td>
<td>ACER CHROMEBOOK 11</td>
<td>LENOVO CHROMEBOOK N20P</td>
<td>SAMSUNG CHROMEBOOK 2</td>
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<tr>
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<td>----------------------</td>
</tr>
<tr>
<td>Screen</td>
<td>13.3” (1366x768) display</td>
<td>11.6” (1366x768) display</td>
<td>11.6” (1366x768) display, touchscreen</td>
<td>13.3” (1920x1080) display (also comes in 11.6”)</td>
</tr>
<tr>
<td>Processor</td>
<td>2.1 GHz Tegra</td>
<td>Intel® Celeron® 2.16GHz (with Intel® Burst up to 2.41GHz)</td>
<td>Intel® Celeron N2830 2.16 GHz</td>
<td>Samsung Exynos 5 Octa 5800 2.0 GHz (2 MB Cache)</td>
</tr>
<tr>
<td>Storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
<td>16 GB SSD, Unlimited Google Drive storage</td>
</tr>
<tr>
<td>Dimensions</td>
<td>0.7 inches thin and 3.31 lbs.</td>
<td>0.7 inches thin and 2.4 lbs./1.1 kg.</td>
<td>0.8 inches thin and 2.5 lbs / 1.13 kg</td>
<td>0.7 inches thin and 3.31 lbs.</td>
</tr>
<tr>
<td>Battery Life</td>
<td>13 hours</td>
<td>8.5 hours</td>
<td>8 hours</td>
<td>8.5 hours</td>
</tr>
<tr>
<td>Price</td>
<td>$279</td>
<td>$199</td>
<td>$309</td>
<td>$379 (11.6” $319)</td>
</tr>
<tr>
<td>DEVICE</td>
<td>ASUS CHROMEBOOK C300</td>
<td>ACER CHROMEBOOK 11</td>
<td>LENOVO CHROMEBOOK N20P</td>
<td>SAMSUNG CHROMEBOOK 2</td>
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<td>----------------------</td>
</tr>
<tr>
<td>Classroom Usage</td>
<td>The ASUS Chromebook C300 features a 13.3-inch backlit LED screen, a generously-spaced keyboard and a wide trackpad, perfect for students undertaking a variety of assignments. The plastic wood grain texture of the cover wraps around the keys and trackpad: helping with handling between classes. Video content is hindered by a poor viewing angle. The device is also on the heavy side, yet with a plastic casing that may not be able to withstand the brunt of student use. The C300 can hit 10 hours with light browsing or working in a document yet streaming video cuts the battery life down to seven or eight hours. If students are just browsing in a couple of tabs, the experience should go smoothly. When four to five tabs are opened, navigation becomes slower, and the system lags.</td>
<td>The Acer Chromebook 11 combines a lightweight fanless design in an 11.6-inch screen casing. Its specifications aren't particularly unique, but its white finish should appeal to students, while its price should appeal to schools and districts looking for 1:1 solutions. The keyboard and touchpad are school-work friendly, while its display — while functional — is a little on the “cheap” side. Its processing power is ideal for Google in Education apps, but not for more intensive tasks such as video editing.</td>
<td>Lenovo's N20p is portable and functional — with a touchscreen for educational apps — but doesn't offer the performance many schools may expect from the higher price-point. The system can feel sluggish when rendering Google documents, or when switching between tabs that display dynamic content, such as stream educational videos. Though rather drab in appearance, the device is rugged to withstand student use. There are plenty of outputs (including a USB 3.0 port) as well as Bluetooth 4.0. The spacious keyboard makes it classwork-friendly, with solid battery life and a slim, lightweight chassis for easy toting.</td>
<td>The device is easy for schools to implement and manage, offering an engaging 1:1 digital learning environment. It boots quickly, and — despite its processor — is suitable for light browsing and research as well as displaying multimedia content. Its textured lid makes it easy to grip when carrying it from class-to-class while adding another layer of durability. Battery life that lasts throughout the school day and a bright, HD display make the Samsung Chromebook 2 a worthy addition to classrooms looking for a cloud-based learning solution.</td>
</tr>
</tbody>
</table>
Android Devices and Operating System

Android is an open source operating system (OS) purchased by Google in 2005. Based originally on Linux, Android launched in 2003 as the Android Open Source Project (AOSP); providing the documentation and source code free of charge to any developer who wanted to use it for creating and selling their own products. Google's purchase in 2005 was intended to get out in front of the then-emerging iPhone threat by acquiring an open source product that could permeate the smartphone market. At the time, Android's smartphone was seen as a way to protect Google interests — as long as people were using Google's phone to search the Internet (it was reasoned) they would have to be using Google. The initial Android smartphone OS was rolled out in 2007, trailing the iPhone release by less than a year.

Android phone sales overtook the iPhone in 2010 and the Blackberry in 2011, establishing it as the leader in the smartphone market. Android's choice to go open source has resulted in it being able to take a staggering 84% market share worldwide. The OS is used in multiple platforms rather than living in one proprietary device, and that has turned out to be a successful strategy. While some manufacturers had already begun to revise Android for use in tablets, Google's reach beyond the smartphone market started in 2011. This began to change Android's position in the overall digital device market, as well as developing a potential in the education space. In the most recent statistics from IDC, Android tablets made up just 2.3% of US education sales, which equates to only about 60,000 devices. However, recent updates to the Android operating system and the management capabilities of Google Play for Education may make Android tablets more attractive to schools.

Android's evolution has been dramatically rapid. In June 2014, Ars Technica (a self-described technical-geek publication) reported:

“Lately, Android has even been running on a previously unheard of six-month development cycle, and that’s slower than it used to be. For the first year of Android's commercial existence, Google was putting out a new version every two and a half months. The rest of the industry, by comparison, moves at a snail's pace. Microsoft updates its desktop OS every three to five years, and Apple is on a yearly update cycle for OS X and iOS.”

“. . . Android tablets made up just 2.3% of US education sales, which equates to only about 60,000 devices.”

In education, it's a case of getting more for less. Oregon's Gervais School District No. 1, for instance, uses Android-based devices to fulfill their curriculum needs because the device's Android operating system is easy to use and because of its comparatively low cost. Cost is a major factor to consider as a difference of a few hundred dollars per device can translate into a much larger rollout when considering a school- or district-wide implementation.
Amplify, which sells schools an Android tablet packaged with content for K-12 classrooms, has been a vocal proponent of Google's platform. The company has argued that Android's open nature enables more school-specific customization, that it's easier to securely deploy and manage a large number of Android tablets over the air, and that it's a better value for budget-constrained schools.\(^{14}\)

In terms of Android, there are many cost-effective options. Students can utilize a relatively powerful 10.1-inch Android tablet for a few hundred dollars, and the Google Play Store offers a wide range of educational apps. Schools and districts could even develop their own education apps and integrate them directly into curriculum with far more ease than with closed ecosystems such as the Nook, Kindle, or iPad.\(^{15}\)

Each Android update is named after a sweet treat and rolls out in alphabetical order. The move from Jelly Bean to KitKat (Android 4.4 launched in October 2013, and as of October 2014 is the current version in use) came with some changes affecting all Android devices, including: Direct access to non-Google cloud storage (positioning Android to support educational users who may be restricted to intranet storage, or cloud storage under contract proprietary contracts); QuickOffice app provided free (allowing Android users to view, create and edit Word, Excel and PowerPoint documents, offering a potential for price savings for educational users who would not need to purchase Microsoft Office for Android devices); and printing API and, for wireless printing (supporting KitKat devices in accessing any printer that has an app in the Play store, offering a potential advantage to classrooms).

Android 5.0 Lollipop was released in mid-November 2014, and brought with it many new changes. It features a new design — flat yet “realistic”, 5000 new APIs, will be contextually aware of its surroundings, and utilize voice as a major input source.\(^{16}\)

Google has also worked beneath the surface to ensure this latest version is the fastest yet, utilizing ART — an optional runtime in Android KitKat — working with ARM, x86 and MIPS platforms to run twice as fast as the Dalvik runtime found on previous Android iterations. Working with Nvidia, Qualcomm, ARM and Imagination Technologies, Google has designed the Android Extension Pack with the sole task of closing the gap between mobile and desktop-class graphics.

Batteries on phones running Android Lollipop are also more efficient. According to Ars Technica, a Nexus 5 running Android Lollipop had around 36% more battery life than one on Android 4.4 KitKat.

Other new features include: Google Fit (a health and fitness tracking program), increased compatibility with Android and non-Android wearables, improved video streaming with H.265 4K, and corporate data separation — allowing protected business-only areas on the device.\(^{17}\) Another new feature allows your Android device to unlock your Chromebook whenever they are close together. Notifications will appear on both devices simultaneously, and there are apps that allow users to “handoff” an item created in one system/device to open on the other.\(^{18}\)

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14 https://gigaom.com/2013/07/18/a-snapshot-of-googles-uphill-battle-getting-android-into-k-12-schools/
15 http://www.digitaltrends.com/mobile/tablets-invading-the-classroom/
18 http://www.pcadvisor.co.uk/reviews/google-android/3529366/android-l-vs-ios-8-comparison-preview/
In Q4 2013, according to research firm IDC, Google’s Android mobile operating system had a 78% share of all users globally. In 2014, Android mobile devices were overwhelmingly the largest seller worldwide: Android phones are held about 84% of the market share.

Google’s control over the Android “killer” apps (Gmail, Maps, Google Now, Hangouts, YouTube, and the Play Store) keeps original equipment manufacturers (OEMs) from forking the Android OS, cloning the apps and setting up a directly competitive product. These key apps (and others that Google is slowly bringing into the proprietary fold) are essential to device sales.

The last part of 2014 and the spring of 2015 may be a watershed moment for Google and Android. Rumors have been rampant since 2013 that Google had plans to kill off Android (in favor of Chrome) but as of now they are re-inventing and re-branding the OS with two new approaches.

**Android One**

Announced in the summer of 2014, this is a hardware complement to the 512MB OS that debuted in KitKat, and is another move to take a significant mobile share in emerging markets. In order to produce and sell devices with the Android One “certification,” companies will be required to sell them with only Google-owned pre-installed apps (no “bloatware”), with Google committing to lifetime Google-provided updates to the OS (fixing the roll-out delays): a benefit that in the past had only been available to Nexus owners.

**Android Silver**

At the other end of the spectrum, Google is expected to announce Android Silver; a set of specifications for devices that will standardize hardware quality at the high end. Similarly to the Android One, Google will provide the initial engineering investment, and then contract with manufacturers to create devices that:

“... ‘closely adhere to Google specifications’ and will ‘sharply limit the number of non-Google apps that can be pre-installed on devices’.”

With Google making such large changes in their attitude toward Android, there may be an opportunity for them to also create an “education only” set of mandated specs that would draw on the developments already in process. Specifying devices that would use the 512MB KitKat, paired with a manufacturer that commits to offload apps and Android “forks” that are not used in typical classrooms, combined with a commitment from Google to push the OS updates (and keep all apps appropriately aligned) could make for a package that is at least as compelling as the Chromebook from a cost and maintenance perspective.

21 [http://readwrite.com/2013/03/07/android-is-dead-long-live-google](http://readwrite.com/2013/03/07/android-is-dead-long-live-google)
22 [http://www.theverge.com/2014/6/26/5845562/android-one-google-the-next-billion](http://www.theverge.com/2014/6/26/5845562/android-one-google-the-next-billion)
Since Google owns both Android and Chrome, there has long been discussion about which of them would be allowed to survive, or if they will simply be merged into one solution. They continue to support both OS frameworks. And as recently as the spring of 2014, Sundar Pichai Senior VP of Android, Chrome and Apps at Google explained Google’s perspective “... view them as building blocks. By investing in both, we believe that over time we will be able to meet almost all use cases.”

Continuing to support both systems makes a certain kind of sense: they are not the same operating system and support very different kinds of devices. Android runs (mostly) through computer-based apps and a Chromebook runs (mostly) on cloud-based apps. Google’s ambiguity is also market-related: Android is hugely popular and holds a significant market-share. Even though Google has not yet found a way to monetize Android at the level they would like (due to open source sharing), they can’t just pull the plug.

In the education space, Android-based devices have the following benefits:

**Versatility**
Schools and districts are looking for affordable, all-purpose technology solutions that will be relevant as long as possible. The Android platform allows for such versatility, which makes it a good match for project-based learning curricula. Android devices are generally affordable and intuitive which helps level the playing field in classrooms.

**Creative Arts Tool**
In the wake of budgetary restraints and eliminated arts programs, Android devices can be an affordable way of sustaining arts-based curricula without the need for costly resources such as paint and canvas. Apps can also provide creative ways of engaging students in STEM subjects, removing common obstacles and helping to highlight the concept behind equations or experiments.

**App-Friendly**
Many schools are embracing app-centric learning. Most Android-friendly apps are built in such a way that they provide a similar, often seamless experience regardless of Android device.

**Speed and Battery Life:** Most Android-devices are fast, efficient, and boast a long battery-life, even with processor-intensive activities such as video capture and editing.

**Compatibility**
Android devices work well with Google Drive — a popular resource for education — and file sharing is often simpler than with other platforms.

**Classroom Management**
Most Android devices — especially tablets — function in a similar way to Android phones, which are a popular choice for students. This helps with the learning curve in the classroom. Android-based devices also work well with Google Apps for Education, helping teachers to be up and running pretty quickly. Most devices are lightweight with bright, clear screens, making them highly useable for most every student or teacher.

---

# Leading Android Devices in Education

<table>
<thead>
<tr>
<th>DEVICE</th>
<th>ASUS TRANSFORMER PAD TF103C</th>
<th>HP SLATE PRO</th>
<th>NEXUS 7</th>
<th>SAMSUNG GALAXY TAB 4 EDUCATION</th>
<th>AMPLIFY TABLET</th>
<th>NEXUS 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Size</td>
<td>10.1”</td>
<td>8”</td>
<td>7.02”</td>
<td>10.1”</td>
<td>10.1”</td>
<td>10.055”</td>
</tr>
<tr>
<td>Processor</td>
<td>Intel Atom quad-core</td>
<td>Allwinner Quad-Core A33</td>
<td>Qualcomm Quad-Core</td>
<td>Qualcomm Quad-Core</td>
<td>Intel Atom dual-core</td>
<td>Samsung Exynos 5 Dual-core</td>
</tr>
<tr>
<td>Storage</td>
<td>16 GB (expandable to 64 GB)</td>
<td>16 GB (expandable to 48 GB)</td>
<td>16 GB</td>
<td>16 GB (expandable to 80 GB)</td>
<td>16 GB</td>
<td>16 GB (expandable to 32 GB)</td>
</tr>
<tr>
<td>Memory</td>
<td>1 GB</td>
<td>1 GB</td>
<td>2 GB RAM</td>
<td>1.5 GB RAM</td>
<td>2 GB RAM</td>
<td>2 GB RAM</td>
</tr>
<tr>
<td>Operating System</td>
<td>Android 4.4 Kitkat</td>
<td>Android 4.4.2 KitKat</td>
<td>Android 4.3 Jelly Bean</td>
<td>Android 4.4 KitKat</td>
<td>Android 4.2 Jelly Bean</td>
<td>Android 4.2 Jelly Bean</td>
</tr>
<tr>
<td>Camera</td>
<td>2MP rear, 0.3 MP front</td>
<td>2MP rear, 0.3 front</td>
<td>5MP rear, 1.2 MP front</td>
<td>3 MP rear, 1.3 MP front</td>
<td>5 MP rear, 1.3 MP front</td>
<td>5 MP rear, 1.9 MP front</td>
</tr>
<tr>
<td>Connectivity</td>
<td>Wi-Fi, Bluetooth 4.0, Miracast compatible</td>
<td>Wi-Fi, Bluetooth</td>
<td>Wi-Fi, Bluetooth</td>
<td>Wi-Fi, Bluetooth</td>
<td>Wi-Fi, Bluetooth, Miracast compatible</td>
<td>Wi-Fi, Bluetooth</td>
</tr>
</tbody>
</table>

For Internal Use

1001 SE Water Avenue Suite 400
Portland, Oregon 97214
503 248-4300
clarity-innovations.com
<table>
<thead>
<tr>
<th></th>
<th>ASUS TRANSFORMER PAD TF103C</th>
<th>HP SLATE PRO</th>
<th>NEXUS 7</th>
<th>SAMSUNG GALAXY TAB 4 EDUCATION</th>
<th>AMPLIFY TABLET</th>
<th>NEXUS 10</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimensions</strong></td>
<td>10.1” x 7” x 0.4” (tablet only) 10.1” x 7” x 0.8”</td>
<td>7.95” x 5.4” x 0.31”</td>
<td>7.87” x 4.5” x 0.34”</td>
<td>9.6” x 6.9” x 0.31”</td>
<td>10.8” x 6.9” x 0.5”</td>
<td>10.4” x 7” x 0.35”</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>1.2 lbs (tablet only) 2.2 lbs (with dock)</td>
<td>0.71 lbs</td>
<td>0.64 lbs</td>
<td>1.08 lbs</td>
<td>0.6 lbs</td>
<td>1.33 lbs</td>
</tr>
<tr>
<td><strong>Media Inputs</strong></td>
<td>Audio Jack Micro USB Micro SD</td>
<td>Audio Jack Micro USB Micro SD</td>
<td>Audio Jack Mirco USD SlimPort enabled</td>
<td>Audio Jack Micro SD Mirco HDMI</td>
<td>Micro USB Micro SD</td>
<td>Audio Jack Micro SD Mirco HDMI</td>
</tr>
<tr>
<td><strong>Google Play for Education?</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Battery Life</strong></td>
<td>Up to 9 hours</td>
<td>Up to 11.5 hours</td>
<td>Up to 9 hours</td>
<td>Up to 10 Hours</td>
<td>Up to 9 hours</td>
<td>Up to 8 hours</td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>$299</td>
<td>$329</td>
<td>$259</td>
<td>$399</td>
<td>$359</td>
<td>$399</td>
</tr>
</tbody>
</table>
OTHER DEVICES

Nexus Player

Nexus is Google’s own line of consumer electronic devices that run the Android operating system. The product family consists mostly of mobile devices. Devices in the Nexus line are considered Google’s flagship Android products. In mid-October, 2014, Google unveiled the Nexus Player (AKA Android TV). Nexus Player (a collaboration with ASUS) is a streaming media player for movies, music and videos that is also a “first-of-its-kind” Android gaming device. Nexus Player is Google Cast Ready (using the Chromecast HDMI dongle) so teachers and students can cast media from almost any Chromebook, tablet, and Android device to a HDTV or monitor.26 It is the first Nexus device to feature an Intel processor, and is priced at $99.

Nexus 9 and the Nexus Player were available for pre-order on October 17 and in stores starting November 3. Nexus Player is powered by the 22nm, quad core, 64-bit enabled Intel® Atom™ processor (Moorefield) and “delivers both speedy performance and a smooth and responsive experience. It offers a console-like gaming experience and the latest and best video compression unlocks up to a 1080p HD viewing experience with fast and smooth video streaming – driven by a Quad Cluster 3D graphics engine with smaller, faster transistors.”27

Some possible classroom applications for the Nexus Player include:

- A means of moving around the classroom while mirroring the content from a teacher’s tablet device, smart phone, or laptop. By standing at the front of the room, teachers often act as barriers to students seeing what’s on the board. Moving around also helps to hold student attention.
- Demonstrating new educational apps or useful online resources
- Sharing student work or allowing students to present their work directly. Sharing of work keeps students motivated, either with the prospect of having an outlet for expression and getting acknowledgment, or to do their best because their work will be judged by peers.
- Correcting documents to highlight common issues in student work. This provides immediate feedback, allowing learning to happen “in the moment”
- Sharing digital textbooks
- Sharing YouTube and Vimeo videos

Chromecast

Chromecast is a $35 thumb-sized media-streaming device that plugs into the HDMI port on a TV or monitor. Most any smartphone, tablet device, laptop or Chromebook can cast digital content to a TV or monitor via Chromecast.

26 http://googleblog.blogspot.com/2014/10/android-be-together-not-same.html
Chromecast works with a growing number of apps where students or teachers can mirror whatever is on the screen of their device.

With Chromecast, a smartphone or tablet can become a remote control to manipulate and present content with no special set-up required. When a user isn’t “casting,” the TV or monitor can be turned into a digital backdrop filled with student artwork, subject-specific photographs, and more.

With the Roku Streaming Stick ($50) and Amazon’s Fire TV Stick ($39), Chromecast faces considerable competition. The Chromecast stick is the simplest of the devices, with no menu-based user interface, remote control, or ability to store information:

“...simply acting as a conduit through which your TV can access content. Find what you want to watch or listen to on your personal device, “cast” it at the Chromecast with the press of a button and, voilà! it’s on your TV. It just doesn’t get much simpler than that...”

Amazon’s Fire TV Stick, however, features a dual-core processor, 1GB of RAM, and 8GB of storage: having 50 percent more processing power and double the memory of Chromecast, and six times the processing power, twice the memory, and 32 times the storage of Roku Streaming Stick. This results in a less “sluggish” experience when casting video content or when gaming. The Roku Streaming Stick features more than 1,000 apps, many of which are free.

**Chromebox**

A Chromebox is similar to a Chromebook, but designed to connect to external monitors, keyboards, etc. It has a slightly faster processor and more peripheral support — which are mandatory, for connecting aforementioned monitors, keyboards, etc. If a Chromebook is a browser with a keyboard, a Chromebox is a browser.

- Price: approx $250
- Processor: Intel Celeron, 1.9 GHz
- Storage: 16 GB SSD, 100 GB Google cloud for two years
- Operating System: Chrome OS
- Memory: 4 GB RAM
- USB: 6x USB 2.0
- Peripheral Support: 2x Display Port
- Connectivity: DVI, Bluetooth 3.0, Gigabit Ethernet

Advantages for schools
· Useful in a lab for students who forgot or damaged their Chromebooks
· Run Chrome OS: seamless experience from Chromebooks to Chromebox
· Useful at a teacher’s desk for managing students, grading, and working in multiple windows

Disadvantages for schools
· Costs add up: monitor, keyboard, mouse, adaptors
· Currently, Chrome OS can’t meet all the needs of a school; Chromebook schools are likely to seek Windows or Mac desktops to complete their needs

ARM vs. Intel
ARM and Intel offer two distinct architectures. Intel chips have, historically, had the best performance but with greater power consumption and price, while ARM chips had the lowest power consumption and are generally cheaper, yet lack the performance of Intel chips. While most iPhones, iPads and most Android smartphones and tablets feature ARM chips, Intel chips have been improving in power consumption and are becoming more price competitive (e.g., Haswell and Baytrail, respectively). Most Windows devices run Windows 8 on an Intel processor, with ARM devices running Microsoft’s Windows RT. Windows RT is very limited and can’t run any non-Microsoft desktop programs at all. Some Chromebooks use Intel chips, while other Chromebooks — such as Samsung’s Series 3 Chromebook and the HP Chromebook 11 — use ARM chips.

According to research conducted by Principled Technologies,29 Intel processor-powered Chromebooks lasted over 57 percent longer unplugged than the ARM processor-based Chromebooks — an additional 4 hours and 5 minutes without a charge — while also requiring up to 50 percent less waiting in four student scenarios. The longer students must wait for apps or documents to open, the more opportunities there are for distractions like chatting and doodling, and the longer it takes to get to learning in the classroom or at home.

Though Android smartphones and tablets have historically run on ARM chips, there are now Android phones and tablets with Intel chips inside. These devices may offer higher performance than ARM tablets. Most Android apps are compatible with both ARM and Intel processors. However, some apps use the Android NDK — native development kit — to use native ARM code and squeeze more performance out of their apps. These apps will generally be performance-sensitive ones, like games. Apps with ARM-specific code won’t run on Intel x86 or x64-based Android devices.30

SOFTWARE AND OTHER SERVICES

The panoply of education-related Google products can be overwhelming — and due to the naming conventions — confusing. Google’s ambitious move into the education space has led to a pattern of “release, repackage, replace, rename” that has led to completely different products having names as similar as Google Drive for Classroom and Google for Classroom and for products like Google Apps for Education being a subset of Google Play for Education, and ancillary products such as YouTube EDU and YouTube for Schools.

Naming aside, the Google education efforts have resulted in a collection of widely adopted products for educators including apps, classroom/device management systems, and access to classroom materials. Many of these services are provided at no charge. By getting its tools into schools and into the hands of teachers and students, Google hopes to create early, life-long adoptees of its tools and platforms.

Google Apps for Education

Google Apps for Education (GAFE) is a free, hosted suite that provides email, calendar, chat, word processing, spreadsheets, presentation tools, a WYSIWYG website builder, and integrated user management capabilities including the just released Google Classroom. All these are cloud-based apps, with storage through Google Drive allowing easy real-time sharing and file backup.

The Google Apps for Education Suite

Tools that your entire school can use, together

Classroom  Gmail  Drive  Calendar  Docs  Sheets  Slides  Sites
Since its introduction in 2006, Google Apps for Education has skyrocketed in adoptions, growing; its user base of administrators, teachers and students from 10 million in 2010\(^{31}\), to 20 million in 2012\(^{32}\) to more than 40 million worldwide in 2014\(^{33}\), and supported on all major platforms. While the exact penetration into international markets is hard to assess, tracking the growth of the EdTech Global Summits provides some insight. In 2012, there were nine summits, with four non-US locations (Mexico City, Singapore, New Zealand, Bombay) totaling 44 percent of the offerings. In 2013 there were 24 summits, which included a second round in all the previous international locations and added four Canadian summits (Ontario, Alberta and two in British Columbia), plus Tokyo, Hong Kong, Seoul, Dubai, Tel Aviv and South Africa (62% international). The 2014 lineup listed 17 locations, with only 6 listed as international locations — none of which are new, but the listing page includes the caveat, “Most 2012 events, 2013 events and 2014 events are now annual events” which seems to indicate the high numbers continue, and the main Google page no longer has to advertise for the individual summit organizers.\(^{34}\)

The rapid growth in use of Google's productivity apps Docs, Sheets, and Slides now poses a major threat to Microsoft Office. In addition to cost, schools regularly point to the integrated cloud storage, collaboration features, and built-in management tools as reasons for their switch.

Initially requiring a full-time connection to the Internet, GAFE has incrementally added capabilities to run offline as outlined in chart below, giving students better access to the tools and removing another a common barrier to the adoption of the product.

### Google Apps for Education Users Worldwide

![Users in millions](chart.png)

### Offline Capabilities

<table>
<thead>
<tr>
<th></th>
<th>DESKTOP</th>
<th>MOBILE</th>
</tr>
</thead>
<tbody>
<tr>
<td>View</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Edit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Google Drive</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Google Docs*</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Google Sheets*</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Google Slides</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Google Drawings</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Google Forms</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

31 http://readwrite.com/2010/10/14/over_10_million_students_now_use_google_apps_for_e
32 http://techcrunch.com/2012/10/01/google-says-apps-for-education-now-has-more-than-20-million-users/
34 https://sites.google.com/a/gafesummit.com/www/2012
Google Drive

Features of Google Drive for Education (GDFE) allows security encryption of all files while in transit and in storage, the ability to organize classroom assignments into folders, single file storage of up to 5TB, and continues to extend Google Apps for Education as advertising free and with the educator review process that ensures usability, alignment with standards and compliance with security standards.

Ownership

The core suite is free to educators and ownership rights of all data remains with the creator. Domains are owned and set up only by teachers, administrators or other adults who are employed by accredited schools, educational institutions and registered 501(c)3 non-profits. Students and non-educator adults are not able to open GDFE or GAFE domains.

Once established, domain holders “provision” users, setting up individual accounts; e.g. a school district may be a domain, and then each teacher is given an account in that domain. There is no limit to the number of user accounts that can be tied to a domain, but moving a user from one domain to another is a manual process.

Security and Privacy

GAFE’s core suite runs the same apps offered to Google Drive users (Gmail, Google Sheets, etc.) but the privacy, advertising and security functions are different than for the general public to ensure compliance with FERPA (Family Education Rights and Privacy Act) and with the US-EU Safe Harbor Agreement. GAFE also complies with COPPA (Child Online Privacy Protection Act) and contractually requires all educational account holders (teachers and administrators) to file signed parental consent forms.

All mail is automatically scanned for viruses and spam and other features such as auto-detection of calendar events. However, GAFE-registered Gmail accounts do not report data to Google for creating ad profiles (while non-GAFE accounts do) and none of the information stored in GDFE accounts is used for advertising purposes. Account or Domain holders can also implement their own or third party mail gateways that support filtering, monitoring and archiving mail for additional security needs.

Access

GAFE account holders can migrate their mail and other data from previously held Google accounts into their new domain fairly easily, and Google provides special customer service just for educators including 24/7 priority email and phone support lines.

Because the apps are cloud-based, users can access work through any device (tablet, phone, computer) and any platform (Mac, PC). The core suite works across all major browsers (Firefox, Safari, Chrome, IE) but many of the non-core apps require access through Chrome.
Add-ons

In addition to the core suite there are a small number of additional apps that educators can bring into their accounts. These include Google Blogger, Google Groups and the Google+ social networking features.

With the Application Launcher for Drive app, users can launch files from their Drive folder directly on their desktop. While the app download shows more than 8 million users, the reviews of the app are very mixed with an aggregate of only 3 stars (of 5). Many users complain about the files crashing or disappearing and the inability to disable or uninstall the app once it has been launched.

Google Play for Education

Google Play for Education (GPE) is a “curated app store” that focuses on device-based apps and other content (in contrast to GAFE’s focus on cloud-based apps). However, it is also as much a device/content-management program as it is a point of access for apps. Its central hub is the GPE online store, which contains apps, books and videos, as well as bulk purchases of tablets. The store allows free trials on apps before purchase, bulk purchases, centralized distribution to classroom devices, and the ability to purchase with POs rather than credit cards.

In order to use Google Play for Education, schools need to:

• Be located in the U.S.
• Have Chromebooks or tablets with a management license

GPE’s release followed GAFE, considered by many to be a direct challenge to Apple’s footprint in the classroom. The release is seen as, “one of the most education-relevant announcements that has been made” due to its educator-friendly focus.

Apps and Content: GPE includes apps and content for Chrome and Android devices. Materials sort by grade and topic, align with common core standards, and emphasize the four “C’s” of 21st Century Skills: Creativity, Critical Thinking, Collaboration, Communication. Materials are for K-12 classrooms and include content in: English Language Arts, World Languages, Mathematics, Science, Social Science, Elective, Open Education Resources (OER), and Tools.

Apps in GPE are stringently controlled so that educators can have confidence in their purchases. All apps must meet the list of criteria provided by Google:

• Apps and the ads they contain must not collect personally identifiable information, other than user credentials or data required to operate and improve the app.
• Apps must not use student data for purposes unrelated to its educational function.

35 http://www.androidpolice.com/2013/11/13/google-play-for-education-has-officially-launched-lets-developers-easily-get-their-apps-into-the-classroom/
36 https://support.google.com/edu/play/answer/6056739?rd=1
38 http://www.edudemic.com/what-to-know-about-google-play-for-education/
39 https://developers.google.com/edu/guidelines
• Apps must have a content rating of “Everyone” or “Low Maturity” (apps with a “Medium Maturity” rating are allowed, if they have that rating solely because they allow communication between students).

• App content, including ads displayed by the app, must be consistent with the app’s maturity rating. The app must not display any “offensive” content, as described in the Google Play Developer Program Policies and content-rating guidelines.

• Apps must comply with the Children’s Online Privacy Protection Act and all other applicable laws and regulations.

• Apps that are not offered free of cost must allow teachers a limited free trial before purchase.

In addition, if the app has ads, the follow restrictions apply:

• Ads are not distracting for students or teachers (this includes Flash-based ads, video ads, and ads that flash or move)

• Interstitial ads are not served in the app

• Ad walls do not appear in the app UI

• Ads do not occupy a significant portion of the screen

• Ads content does not exceed the maturity rating of the app

• The app declares the use of ads at the opt-in stage40

In addition, all Android apps are required to comply with the standard criteria for Android app development (e.g. icon use, navigation standards and other UI/UX standards41). App developers are further warned to test their items in an environment that simulates typical classroom use, e.g.

• Bluetooth disabled

• No in-app purchases

• Location services disabled

• Internet disabled

• Running on a proxy server

Google has established a third-party network of educators42 to review all apps to ensure they meet all the criteria and to assign them to appropriate standards for search tags. In addition,

Google is paying teachers to review apps in use, and those apps are tagged with a yellow badge.

Deploying apps is easy: simply tap the admin tablet to the new tablet. Students are each assigned an Apps for Education cloud account and all apps back up to their individual account to save work.

40 https://developers.google.com/edu/guidelines
41 http://developer.android.com/distribute/essentials/quality/core.html
42 http://www.zdnet.com/google-launches-play-store-for-education-7000023184/
Books are deployed and read on the Google Play Books app, which can handle both epubs and pdfs.

**Devices**

Google's push into the education market is based on finding ways to save teachers time. One aspect of that is allowing the purchase of apps and bulk devices all in one place. Currently the GPE store offers the Nexus 7 Android tablet, the 10-inch ASUS Transformer (2-in-1), the 10-inch Samsung Galaxy Tab 4 Education and the 8" HP Slate 8 Pro.

The GPE model is built on a 1:1 premise. Although Android 4.2 and later supports multiple users this is not an option inside the GPE ecosystem, so educators can really only take advantage of the package if their school has adopted 1:1. Due to this significant limitation, school libraries/media centers are not looking at the program as viable and are instead still more interested in iOS or Chromebook devices.

**Chrome Web Store**

For educators who would like to move beyond the core GAFE suite, the Chrome Web Store provides more than a million apps, extensions, and add ons. Unlike the GAFE suite, these are not all free, and unlike Google Play for Education, they have not been reviewed or otherwise aligned with educational content.

The Chrome Web Store was launched in 2010 and in the past four years has grown to include extensions, apps, and most recently apps specifically for Android devices. The extra functionality added to Chrome and Google Apps for Education by extensions, apps, and add-ons increase the competitiveness of Chromebooks and Google devices in the education market and position Google to effectively deploy their own OS, running on top of any platform.

**Extensions, Apps, and Add-Ons**

Extensions modify and enhance the functionality of the Chrome Browser. When an extension is installed from the Chrome Web Store, an icon is usually added on the right side of the omnibox, or address bar. Extensions can increase the usability of Chrome for students and teachers alike. Bookmarking extensions like Diigo can aide in organization, productivity extensions like Snagit allow for easy screencasting right from the browser, while others extensions, such as Adblocker, help to create a more education-friendly user interface. Extensions are mostly developed by 3rd parties but popular Google-created extensions include Hangouts, Google Voice, Google Translate, and Google Cast.

When Google changed the Chrome Extension Gallery into the Chrome Web Store in late 2010, it added the ability to install apps. Currently, there are two types of apps. Hosted Apps live in Chrome browser windows and are basically direct links to a website application. Metadata permissions are granted through Google streamlining the experience for the user. Packaged Apps, released in 2013, are native applications built with web technology in accordance with Content Security Policy (CSP) that launch directly from the desktop. Packaged Apps, which open in their own window, increase the usability of Chrome and Chromebooks by allowing for offline use and interaction with connected devices via bluetooth or USB. Google Keep, the collaborative note taking app, is a good example of a Packaged App developed by Google.

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43 http://www.thedigitalshift.com/2013/12/k-12/google-play-education-now-offer/
44 http://chrome.blogspot.com/2013/09/a-new-breed-of-chrome-apps.html
In addition to extensions and apps, Google Drive supports Add-Ons, extra features that extend the functionality of tools in the Google Apps for Education Suite. For example, EasyBib will facilitate the creation of a bibliography in Google Docs, Flubaroo will automatically grade responses from a Google Form, and teachers can use Doctopus to create copies and share assignments with groups of students. In contrast to extensions and apps, add-ons are not installed via the Chrome Web Store. Add-on are managed from the menu bar within Google Apps.

Access and Security

There is a section inside the Chrome Web Store marked “Education” which includes apps by category:

- Academic Resources
- Family
- Foreign Languages
- Teacher and Admin Tools

However, once inside each section there is no handy search tool (as there is in GPE) or reviews by other educators, and no guarantee that the apps comply with COPPA, FERPA or other privacy requirements for students. Using the management console to manage devices can help to manage apps available to students on Chromebooks and will be discussed in more detail in the Management section.

The Chrome Web Store has had two fairly notorious malware infiltrations which may make educators wary of purchases. This vulnerability is not likely to change anytime soon because Google’s app checking is not like that of Apple or Windows, “Apple and Microsoft vet apps before allowing them to post on their app stores, but Google’s automated scanning procedure checks new apps after they appear in the store.” The sheer number and naming of the apps makes the Chrome Web Store difficult to browse or search, which makes Google Play for Education a more efficacious choice for teachers.

Instructional Materials and Educator Professional Development

CONTENT

While very active in creating tools for students, teachers, and administrators in the education space, Google has not demonstrated much ambition towards getting involved in the creation of educational content. Google seems more interested in defining the tools and devices students use to learn than the specifics of what they learn. However, Google is active in the online education space, has partnered with a handful of publishers on occasion, and developed some curricula to support the use of Google tools and devices.

Online Education

Google has been active in the online education sector and is an advocate for increasing accessibility in education. Drawing on their development of Course Builder, a tool for creating online courses, Google partnered with edX in 2013. EdX, a non-profit consortium of leading global universities, is one of the three major MOOC providers, alongside Udacity and Coursera. Using its experience with Course Builder, Google is supporting the creation of Open edX, an open source tool for creating online courses. Over 100 Open edX courses are available at edx.org and more will soon be available at mooc.org, a website still in development by edX with support from Google.47

Google also maintains its own site dedicated to open online education. The resource includes a sampling of Google-created MOOCs, lessons learned from Google’s experiences, and an Online Course Kit. The Online Course Kit helps individuals design online courses and use Course Builder.

Partnerships with Publishers

Google has recently collaborated with a handful of education publishers. These efforts have not been focused on the creation of educational content but have instead been focused on making digital education content available for purchase or rent in the Google Play store or within a publisher-created learning management systems (LMS).

• Pearson worked closely with Google to ensure that their LMS, OpenClass, integrated with GAFE. OpenClass is discussed in more detail in the third party management tool section.

• Higher education students can purchase and, in some cases, rent textbooks from the Google Play store after Google partnered with five large textbook publishers in 2013. The new category in the books section, not only saves students from the burden of heavy textbooks, but also allows students to sync content and notes across devices, including Android and iOS tablets and phones.48

• In early 2014, Houghton Mifflin Harcourt (HMH) announced a partnership with Google to make some of their K-12 educational content available on Google Play for Education. The digital content, beginning with both math and literature and soon expanding to more, will be readable on Android tablets, Chromebooks,

47 http://googleresearch.blogspot.com/2013/09/we-are-joining-open-edx-platform.html
and on Play Books readers. Instead of purchasing content outright, teachers pay for access to content for 180 or 360 day periods, giving them flexibility to change curriculum and upgrade versions.49

Curation and Delivery of Content

Google's biggest foray into the world of collecting and curating actual educational content is YouTube. For much of its existence, YouTube has been viewed with skepticism within an education community worried about distracting, low-quality, or inappropriate content. Many schools even choose to block the site from their network. Google purchased YouTube in 2006 while still in its infancy, and since then, the amount of content on the site has exploded. Recently, Google and YouTube have been actively promoting the use of video in schools as an instructional strategy and a powerful tool for learning. Universities, companies, organizations, K-12 schools, and individual professionals and educators routinely upload educational videos to YouTube, which is becoming more and more trusted by teachers and schools. YouTube has also taken measures to ameliorate the concerns of schools and promote itself as source for reliable, quality content including the following:

• YouTube.com/EDU
  YouTube curates a collection of videos suitable for schools in an educational channel, YouTube.com/EDU. The channel includes more than 750,000 videos and has more than 10,000,000 subscribers. Educators and learners can also subscribe to grade level- and subject area-specific categories.

• YouTube.com/Teachers
  YouTube also manages a channel dedicated to helping teachers integrate the use of video, especially YouTube videos, into their professional practice. Even though mentioning 400 video playlists “aligned to the common core,” at this point, the channel is not very developed beyond one video highlighting YouTube's use in a case study school.50

• YouTube for Schools
  In 2011, YouTube launched a portal for schools that limits the available YouTube content. With three levels of accounts — students, teachers, and administrators — the service aims to meet everyone’s needs. A school’s collection automatically includes the YouTube.com/EDU videos and administrators and teachers can add supplemental videos at their discretion. Within a student account, all ads, comments, and related videos are hidden.51

Much of YouTube's content comes from independent contributors and YouTube appears to foster this ground-up approach within education as well. Although substantial content comes from reputable schools and organizations much of it is also comes from teachers interested in flipping their classrooms or delivering their lessons to larger audiences. The Education Playbook Guide helps people craft effective instructional videos and YouTube's Creator Academy helps people develop their YouTube skills — from starting a channel to getting viewers to earning money.52,53 While not specifically creating content for education, Google clearly views YouTube as a promising portal into the world of education content.

50 https://www.youtube.com/user/teachers/about
51 http://www.nytimes.com/2012/03/10/education/youtube-finds-a-way-off-schools-banned-list.html?ref=stephaniestrom&_r=0
With the recent launch of the Connected Classroom program, Google is establishing Google+ and Hangouts as educational tools. Again, like YouTube, Google is not creating the content; instead it's attempting to create an effective platform to deliver and curate content. The Connected Classroom Google+ community is limited just to educators and helps teachers establish connections with remote classrooms. Teachers can post and respond to requests from other teachers looking to meet in live Hangouts On Air. Beyond simply providing a platform for establishing teacher to teacher connections, Google brings outside organizations into the Google+ community as tour guides. These organizations — including, among others, National Geographic, the San Diego Zoo, and Thomas Jefferson's Monticello — apply to lead virtual field trips via Hangouts on Air on established days and times. Student have a chance to tour facilities, converse with professionals, and extend learning beyond the traditional classroom. While both Google+ and Hangouts have many educational uses, both tools are faced with burdensome age requirements. Google is displaying the educational benefits of these two tools with Connected Classrooms.54

Google-Created Curricula

Google has also steered clear of creating actual curricula for teachers to use with GAFE. While it does provide substantial resources for teachers looking to learn the tools (covered in a subsequent section on Professional Development for Teachers), Google does not attempt to delineate specific ways to use the apps beyond occasional case studies. Google primarily leaves the creation of curricula up to teachers and schools themselves with two notable exceptions:

- **YouTube Digital Citizenship Curriculum:** The series of 10 lessons with videos available in 6 languages besides English covers general digital citizenship topics ranging from detecting lies to cyberbullying to privacy. In addition, the curriculum educates secondary students on YouTube specific topics including YouTube's policies, being a responsible member of the YouTube community, and reporting inappropriate content.55 While teaching students important skills, the curriculum is clearly addressing skepticism towards YouTube and promoting its use as tool that is safe and valuable in the school environment.

- **EngageCSEdu:** Google also recently launched EngageCSEdu in partnership with the National Center for Women and Information Technology (NCWIT). EngageCSEdu, a collection of open source introductory computer science materials and lessons, "supports computer science educators invested in improving engagement and retention in their classes."56

PROGRAMS FOR STUDENTS

Google operates a range of programs for students at all levels. Megan Smith, former vice president of Google[x] wrote in the first entry of the Google for Education blog, “One of our goals is to help more students feel engaged and love learning, to encourage their curiosity, to let them work together, to try something new, to make stuff, and to always try again.”57 At every level, Google's programs introduce students to computer science and connect students with Google tools. Beyond inspiring students to pursue careers in technology, Google also seems to use its content and programs at the higher education levels to create useful open source code and identify possible recruits for future employment.

54 http://techcrunch.com/2013/11/04.google-connected-classrooms/
57 http://googleforeducation.blogspot.com/2014/08/welcome-to-google-for-education-blog.html
K-12 Programs

Google's programs for K-12 students are primarily focused on improving access to technology for disadvantaged and underrepresented populations, introducing students to Google applications, and generating interest in STEM-related careers especially computer science.

- Google Rise Awards: Interested domestic and international organizations that promote computer science education for youths under 18 can apply for a Rise grant. Priority is given to efforts that provide opportunities for underrepresented populations in the technology sector including girls, minorities, and socio-economically disadvantaged students. Grant amounts range from $5,000 to $25,000 for each organization.

- Computer Science for High School (CS4HS): This grant program helps support computer science instruction in high school through teacher professional development. Since 2009, more than 12,000 teachers and an estimated 600,000 students have been impacted by the program worldwide. 58

- Made with Code: Made with Code is a website dedicated towards introducing primary students to computer science. In addition to a number of online tools teaching coding basics, the site also shares inspirational examples of how coding is used in the real world and connects students with the coding community and local opportunities. Although Google is a listed supporter of the code.org's Hour of Code, Made with Code is an unrelated effort.

- Google Code-in: This annual contest was developed after the success of Google's Summer of Code program for higher ed students. In the contest, students connect with mentors and build real world experience with open source development.

- CS First: CS First provides teachers, parents, and volunteers with no computer science background with the materials and know-how to start their own cs club for students age 9 to 15.

- Google Science Fair: Open internationally to any 13 to 18 year-old, the contest features prestigious judges and large awards for students with the best science and technology projects.

- Maker Camp: This 6-week virtual summer camp — with projects, activities, and conversations with professionals — is run on a Google+ community. In addition to introducing youth to the maker movement, it also introduces students to Google+ and Hangouts on Air.

Higher Ed Programs

In program offerings for university students, Google continues its efforts to promote STEM careers and further introduces students to Google apps. Beyond the continuation of objectives from the previous level,

58 http://googleforeducation.blogspot.com/2014/10/helping-teachers-teach-computer-science.html
Google introduces a series of programs that start grooming students for potential work opportunities in the technology industry and with Google.

Google actively promotes the use of its apps and platforms in universities worldwide with the Student Ambassador Program. In the year-long program, ambassadors attend a workshop before serving as liaisons between Google and their campuses. Ambassadors must be enthusiastic about new technology — Google technology, specifically — and be willing to commit 10 hours per month to Google evangelist work. Ambassadors organize events to get other students excited about Google products and provide Google with valuable insight into university students’ culture. In most parts of the world, the program is open to interested applicants, however, in some locations — including the United States and Europe — the program is by nomination only and limited to students that Google has met previously.

Google hosts a series of contests for higher education students. The contests are a way for Google to promote its name as well as connect with future employees.

- Google Online Marketing Challenge: Using a $250 dollar budget, teams of 3 to 6 university-enrolled students use Google Adwords and Google+ to run a 3-week advertising campaign for a business or non-profit.

- Summer of Code: Selected students, age 18 or older, work with one of 177 global mentor organizations on an open source project. Students receive a stipend for their coding work and connect with possible future employment opportunities. In Google’s view, the program is not specifically a recruiting program, although it does use results to identify possible recruits. According to Google, “the more code out there, the more everyone benefits.”

- Code Jam: In this highly-competitive contest, open internationally to students and non-students alike, participants solve coding problems in a limited amount of time to move onto the next round. Code Jam is open to students age 13 and older but only students 18 or older can attend the onsite finals.

Some of Google’s higher education programs introduce students to career opportunities that, while maybe not directly connected to computer science, have great implications for Google’s business.

- Google Policy Fellowship: The summer program offers undergraduate, graduate, and law students the opportunity to work on internet- and technology-related policy issues at various public interest organizations.

- Journalism Fellowship: Google invites selected fellows to spend one week at a Google facility before spending 9 weeks at outside journalism organizations throughout the United States. The fellowship is tech-related focusing on “data driven journalism, building news apps, online free expression, and rethinking the business of journalism.”

60 http://www.google.com/get/journalismfellowship/
At the university level, Google also offers highly competitive, more in-depth programs and internships for students to experience Google-specific work:

- **Computer Science Summer Institute**: This 3-week all-expense paid summer camp at a Google Facility targets incoming college freshman enrolled in a computer science-related program. Not only are students learning about computer science, they are also introduced to Google's “unique and innovative office culture.”

- **BOLD Intern Program**: The Building Opportunities for Leadership and Development Intern Program places students from populations under-represented in the technology industry in teams across Google's business from advertising to human resources.

- **Internship and career programs**: Google also offers a wide-variety of summer internships in computer science, engineering, and user experience at their facilities worldwide through an application process.

### PROFESSIONAL DEVELOPMENT FOR TEACHERS

Google's model for getting its devices, platforms, and apps into schools starts with teachers. Through an overlapping web of online and face-to-face communities and learning resources, Google seeks to train and inspire a passionate base of teachers. Teachers develop use and instructional strategies for Google tools, give back to Google education community, and help turn more and more educators onto educational possibilities with GAFE, Chromebooks, and Android tablets.

### Certification

Google recognizes the expertise of highly qualified individuals through a range of four certification options. By certifying an active and inspired group of educators, Google identifies and prepares teachers to promote and teach Google products at schools, workshops, and edtech conferences.

1. **Google Certificate of Achievement**: Teachers that pass the free, 30-multiple choice question Google Basics Exam achieve this certificate that does little more than familiarize teachers with GAFE and introduce teachers to subsequent levels of certification.

2. **Google Educator**: To become a Google Educator, teachers must pass a series of online exams. The comprehensive exams, each with 60 questions, align with content covered in online training courses for teachers discussed in the next section. Google Educators must pass four core exams covering Gmail, Calendar, Docs and Drive, and Sites. In addition, teachers are required to pass at least one elective exam on a topic selected from Chrome Browser, Chromebooks, Tablets with Google Play for Education, or Implementing Google Apps. Each online exam costs fifteen dollars per attempt. Becoming a Google Educator is the first step in attaining the following two levels of certification.

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61 [https://www.google.com/edu/programs/computer-science-summer-institute-cssi/#!overview](https://www.google.com/edu/programs/computer-science-summer-institute-cssi/#!overview)
3. Google Certified Teachers (GCT): Teachers interested in becoming a GCT, apply to attend a two-day Google Teacher Academy (GTA). GTA’s are free-of-charge and exclusive — limited to around 50 individuals and held only a few times each year in worldwide locations. Teachers who achieve GCT status evangelize about Google products and often present at Google events and summits to help broaden the reach of the Google toolkit.

4. Google Education Trainers: Through an application process, Google recruits educators to conduct trainings on its behalf. Trainers are knowledgeable and passionate about Google’s products, demonstrate a successful education training track record, and curate an online and social media presence. Additionally, trainers have to conduct at least three Google specific trainings annually and keep their Google Educator status up-to-date to maintain their status.

Google also authorizes 3rd party training organizations, integral to Google’s outreach strategy. These organizations, often made up of GCTs or Google Education Trainers, help Google by hosting workshops and conferences centered on teaching others how to use Google apps and platforms. At this time, authorizing 3rd party organizations is on hold. Some of the more prominent authorized organizations include:

- Computer Using Educators (CUE)
- AppsEvents
- EdTech Team

**Live and Online Learning Resources**

The Training tab on the Google for Education page hosts a wealth of online resources for teachers to advance their skills with Google apps and platforms. Each topic includes series of increasingly complex lessons supporting learning through text and screencasts. The lessons not only support proficiency with basic device and tool functionality but also introduces teachers to example classroom use cases. “Apply in Class” resources extend teacher learning with each tool or device by connecting teachers with resources outside of the Google for Education web site.

In addition to learning online, teachers can attend face-to-face workshops focused on Google technology. Google Education Summits, taking place at the regional level around the United States and world, combine keynote speakers with a choice of tool-related workshops. Google Education Summits are hosted by 3rd party training organizations which often charge attendance fees over 200 dollars. Schools or districts interested in adopting GAFE frequently host onsite events led by GCT’s or Google Education Trainers. Education on Air uses Google Hangouts to connect teachers with live professional development opportunities. In addition to these Google-specific opportunities, GAFE, Chromebooks, and tablets are frequently showcased by GCTs and Google Educators at general education technology conferences and edcamps.
Google is actively attempting to increase teachers’ basic computer and google proficiency levels in underserved communities worldwide with the Google Educator Group (GEG) Curriculum, created in partnership with the Indian organization, INK. The curriculum, part of a “Get the Next Billion Online” campaign, attempts to “extend the reach of the Internet to teacher and participant communities that lack awareness and infrastructure.” After completing the 21-lesson training, the hope is that these teachers will transfer new learning to their students and communities and possibly start a local GEG. These educational efforts to grow computer literacy skills in underserved communities work well with Google’s recently launched Android One, a smartphone built for users in developing countries. Not only is Google taking the humanitarian position of increasing accessibility to the Internet, Google is also tapping into a large, new worldwide market.

Communities

Google provides many venues for educators to communicate, collaborate, and support each other in using tech tools in the classroom, especially Google tools. Many of these opportunities are teacher-created and operated. Google Educator Groups (GEGs) are independently-run communities of teachers organized around the world, although Google may support groups in their start-up or incubation phase. While discussions frequently include Google-related topics, discussions are open to any education technology topic. Each GEG facilitates face-to-face events and also maintains an online presence using Google+. In addition to GEG pages, Google+ hosts a wide variety of pages and communities supporting teachers with Google tools. Some, such as the Google for Education page is operated by the Google team. However, the majority of pages are created by Google Education Trainers, GCT’s, or interested teachers who use Google tools in their professional practice. Many of these Google+ pages are vibrant communities allowing teachers to exchange information and actively develop their knowledge and skills.

Device, Account, and User Management Tools

Ease of management, especially for large device deployments, is one of the most frequently cited reasons why schools are moving to the Google ecosystem. As such, Google continues to refine and build upon the administrator toolset it makes available to schools, all largely for free.

GOOGLE ADMIN CONSOLE

The Google Admin Console is a single centralized dashboard that school technology administrators use to manage their school or district’s Google services. This includes everything from creating and managing user accounts, to managing mobile devices, to configuring settings for Google Apps, Classroom, Vault, and other services schools may be using in the Google environment.

62 https://drive.google.com/folderview?id=0BxQkc5KBA9IlZzZuRVVxNHBlKdDA&usp=sharing
63 http://googleblog.blogspot.com/2014/09/for-next-five-billion-android-one.html
Configuration

Google offers a number of options for setting up and managing GAFE accounts. Detailed instructions and transition guides are available to help simplify the migration from other products including Outlook, Exchange and Lotus Notes. Google also provides tools that schools can use to integrate GAFE with existing accounts and passwords.

Deployment tools include:

- Google Apps Directory Sync synchronizes LDAP directory data with a GAFE domain. It automatically adds, modifies, and deletes information to match data on a student information system (SIS) or management information system (MIS).

- Google Apps Password Sync automatically keeps users’ Google Apps passwords in sync with their Microsoft® Active Directory® passwords. Whenever a user’s Active Directory password is changed, GAPS immediately pushes the change to Google Apps.

64 http://setup.googleapps.com/Home/special-topics#migration
65 https://support.google.com/a/answer/106368?hl=en
66 https://support.google.com/a/answer/2611859?hl=en
**USERS AND GROUPS**

Users and groups can be added through a variety of methods including upload of .csv files, LDAP sync, or via provision through Clever or LearnSprout. In the Google universe, sharing permissions are set via the use of Groups. Typically Groups are created for each year or subject so that teachers and students can share Google Docs and other items via the Google Group. Groups are different than Organizational units, which are used to control which settings and device policies are available to users (described below). The User dashboard gives administrators a view of each user's account information, including usage statistics, apps enabled, group membership, organization, devices assigned and security settings.

![User Dashboard](image)

Organizational units

Organizations and (nested sub-organizations) give administrators the control to apply different settings to different sets of users or devices (for example giving different permissions for teachers and students). A user or device belongs to only one organizational unit and inherits that organization's settings. Changing a setting at a higher level changes the setting for all sub-organizations that inherit that setting. When subsequent configuration settings are made in the Admin Console, administrators can precisely select the organization they want to configure. Users or devices in that organization get the new setting.

**Device Management**

Chrome device management

For administration, most schools purchase Chrome device management for their Chromebooks. At a lifetime cost of $30 per device, this service is available either directly from Google or an authorized reseller and allows technology administrators to manage Chromebooks with the Admin Console. Each device must
first be enrolled in the school’s domain, and additionally administrators need to create a GAFE account for each user in their organization. These accounts are then used to log in to the organization’s Chromebook devices.

Chrome Settings and information available in the Admin Console include:

• **User settings**
  Administrators can configure policies for users within an organizational unit (such as a school, grade level or class). Apps and extensions can be pre-installed, allowed or blocked for each user or organizational unit.

• **App Packs for Education**
  In addition to offering thousands of Chrome apps *À la carte*, Google also offers schools the ability to purchase sets of curated applications from the Chrome Web Store that are tailored to the needs of Elementary, Middle or High School students69.

• **Device settings**
  Admins can configure policies for enrolled Chrome devices within their organization. The policy applies to anyone who uses the device, even if they log in via Guest mode or sign in with a Google account outside of the organization.

• **Network**
  Admin control of Wi-Fi settings for all Chrome devices enrolled in the domain, or specific sub-organizations within the domain.

• **Chrome devices**
  Lists the Chrome devices in the domain (and organizational unit) and provides information including serial number, status, latest activity, user name, and location.

• **Shipments**
  Ability to view device shipment details if ordered directly from Google.

**Google Apps mobile management**

In addition to Chromebooks, the Google Admin Console supports management of Google Apps on mobile devices including Android, iOS, Windows Phone, and smartphones and tablets using Microsoft Exchange ActiveSync. Features include the ability to configure mobile settings by organizational unit, control what devices can connect to users’ Google Apps data, view mobile devices in an organization, manage Google Play for Education settings, and view all apps that access Google Apps data installed on an Android device.

69 [https://www.google.com/chrome/education/webstore/app-packs.html](https://www.google.com/chrome/education/webstore/app-packs.html)
iOS Sync

Just Introduced in Sept 2014, iOS Sync for Google Apps integrates Google mobile apps with native iOS device management extending Google's ability to run and manage their tools on top of other operating systems. Features include:

• **Ability to manage Google Apps**
  Set a policy that prompts students to enroll their device when they log into Google Apps such as Google Drive and Gmail.

• **Configuration of WiFi networks**
  Distribute WiFi passwords and certificates to students so they can easily connect to trusted networks.

• **Support for existing policies**
  Manage password requirements, data encryption and camera policies, as well as actions like remotely wiping a device, activation approvals and blocking devices.

**GOOGLE CLASSROOM**

Launched in August 2014, Google Classroom looks poised to make a significant impact in educational technology. Like other Google education products, Classroom is free and available to any schools using GAFE. In recent years, the Google Drive collection of products including Docs, Sheets, and Slides has been chipping away at Microsoft Office market share, and the added features of Classroom are likely to expedite this shift.
Essentially a very lightweight LMS, Classroom overlays GAFE and provides teachers the ability to easily create and collect assignments electronically. Folders are automatically created in Google Drive for each assignment, and students can keep track of what's due on an assignments page. When starting new assignments, Classroom automatically makes a copy of a Google document for each student.

In many ways, Google Classroom tries to emulate the classic workflow between students and teachers. Teachers can either invite students individually, or more commonly they share an invitation code that allows students to join a class. The teacher first creates an assignment, selects an associated Google document, and then chooses to “make a copy for each student.” Assignments and announcements are displayed in a stream much like posts on Google+. Each item contains a title and description, as well as links to a files, videos, or URLs. A due date/time can also be included with an assignment.

Each student edits their respective Google document to complete the work. Both the student and the teacher have editing permissions giving the teacher the ability to provide feedback through the entirety of the assignment. When finished, students click a “Turn in” button. The teacher can see a list of completed assignments and select each to review. During review they can add comments and assign a grade (100 pt scale only option currently). Finally, they can return the work back to the student.

While Google Classroom offers a way to easily distribute and collect assignments, it doesn't include many features found on full scale LMS products. These typically include lesson planning, certification management, reporting, or integration with third-party gradebooks (currently only option is to export the grade as an xls file). Classroom currently does not integrate with any third party apps, and Google claims that part of the reason is that it's being more cautious with student data, according to Zach Yeskel, a product manager on the GAFE team.70

**GOOGLE CLOUD PRINT**

Google Cloud Print is a technology that connects printers to the web. Using Google Cloud Print, schools can make appropriate printers available to students and faculty. Cloud Print works with a full range of devices including phones, tablets, Chromebooks, and PCs. Printers can be connected either as a Cloud Ready printer (can connect directly to the Internet) or a classic printer that is plugged into a Windows PC or Macintosh and running the Chrome browser. Chromebooks are set up by default to use Google Cloud Print to connect a printer.

**Issues**

In Intel educator trainings for schools moving to Chromebooks, Google Cloud Print comes up as one of the most troublesome features for schools to set up and manage.

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70 https://www.edsurge.com/n/2014-08-12-google-classroom-s-doors-open
GOOGLE PLAY FOR EDUCATION

Via the Admin Console, administrators have full control over which Google Play for Education materials are available to teachers and students. Google Play for Education is a collection of free and paid apps, books, and videos for Chromebooks and Android tablets that have been vetted for K-12. Teachers can then share selected materials with their students as desired. Google appears to have a strategy of blending the Android and Chromebook environments with the App Runtime for Chrome (Beta). The new project allows Android apps on to run on Chrome OS.

THIRD PARTY MANAGEMENT TOOLS

A growing number of companies are working to integrate their products with GAFE. As noted earlier, however, Google Classroom currently does not support integration with any third party apps. It will be interesting to see if Google will continue to provide room for these third party tools to coexist in the GAFE environment or if Classroom's development in conjunction with the management capabilities of the Admin Console will undercut their purpose.

Hapara

Until the announcement of Google Classroom, Hapara's Teacher Dashboard was the tool of choice for schools wanting to add the ability to organize Google Apps by classroom and assignment. However, Google Classroom competes directly with many of the core features of Teacher Dashboard, and at a price of free vs the $2-4 /per student cost of Hapara. For the time, Hapara does offer some features that Classroom does not — ability to work with Google products other than Drive files (Sites, Blogger, Gmail, Google+); “more flexible workflows”; and more direct customer support. It remains to be seen however, how important these features are to educators, and if/when Google decides to add these features to Google Classroom in the future.

Pearson OpenClass

OpenClass integrates with GAFE, enabling single sign-on and content import. Users can launch OpenClass directly from within their Google Apps account, and can access their Google applications through OpenClass. The free platform includes a digital content marketplace and is available on both the Google Play and Chrome Web Stores. However, since Open Class's launch in 2011, other LMS's such as Schoology have also built Google Drive into their platforms and according to 2014 research by Captura, OpenClass is not among the top 20 LMS solutions.71

gScholar for Google Apps & Chrome

GScholar also extends administration functionality of GAFE via geolocation, student tracking, and asset management technology. The dashboard provides a bird's eye view of each class and notifies administrators of violations to web browsing and geographical boundary policies.

71 http://www.capterra.com/learning-management-system-software/#infographic
Leadership and Policy

PLANNING AND IMPLEMENTATION

Google offers a number of different online resources for districts to use while planning and implementing Google for Education products. Their main resource that is offered is the Google for Education IT Guide, which includes documents on Planning, Deploying and Support.\(^ {72}\) Google also has a Google Document called the Essential Resource Guide that includes a list of links to resources before going Google, getting started, and best practices from schools and districts who chose Google.\(^ {73}\) Many of the resources in the Essential Resource Guide can also be found in the IT Guide, and there are many other additional websites and resources for planning and implementing the various Google products.

Planning Resources

Cost Savings Calculator

Google has two tools to help calculate the cost savings of choosing Chromebooks for schools or districts. One is a simple calculator that estimates savings from choosing a Chrome vs. PC deployment by having the user enter the number of students and faculty. The other tool that Google has developed, through IDC, is a custom white paper that goes into more depth about cost savings based on specific devices and involves entering more school or district information.\(^ {74}\)

To generate the IDC customized White Paper, an IT administrator enters information about the school and district including: the model of Chromebook the school or district is considering, the number of faculty and administrative staff, the number of students, the average salary or faculty and administrative staff, the average salary of IT staff members, the number of student devices, and the total number of devices in the organization. Lastly, the IT staff member enters the current distribution of devices in the categories of desktop, laptop, Chromebook, netbook and tablet. Immediately, the 3-year savings of replacing the current environment is shown on the screen; however, in order to download the complete white paper, the user must enter their personal information including email, name and address.

The generated whitepaper is a comprehensive 20 page document that includes detailed cost savings analysis when compared to alternative devices based on the information that the school or district provides.

Device Grants

The Device Grants resource provides an overview of both Chromebooks as well as Google Play for Education in addition to providing grant information. It includes grant websites, individual grants, online fundraising, alternative options and grant writing links.\(^ {75}\)

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\(^{72}\) https://www.google.com/edu/it/

\(^{73}\) https://docs.google.com/document/d/16pGXaoX6CtWVYk2019PgtsZnZP80_2gWmaxKSLB18/edit?usp=sharing

\(^{74}\) https://roianalyst.alinean.com/idc/AutoLogin.do?d=84798879597028587

\(^{75}\) https://docs.google.com/document/d/1clRXjJGuxkBhXAgAy-tZIg9Q9BM9kH7DoHGJTK2-Zk0k/edit?usp=sharing
Success Stories
Google has a number of success stories from schools, districts, and individual students who are using GAFE, Chromebooks and Tablets with Google Play for Education. Specific examples of schools using these products are located in the appendix.

Chromebook Specific Resources

• Pilot Guide
A guide to a successful Chromebook pilot program including initial assessment, developing a strategic program, implementing a pilot program, selecting a device, training teachers, and a successful deployment. The guide includes interviews and resources from districts and schools who have deployed Chromebooks.

• Chromebook Assessments Guide
This guide shows three different scenarios for how to set up Chromebooks in the management tools for assessments. The three scenarios include: school setting up Chromebook to run as a Single App Kiosk running the exam app, the testing provider setting up student accounts for assessments, and the school setting up public sessions with student devices.

• Administering Chrome Devices for Education
A technical planning guide for IT professionals, school administrators, and teachers that covers considerations and questions to be aware of when evaluating Chrome devices.

Google Apps Specific Resources

• Change Management Guide
This guide is for IT professionals, project managers and institutional leaders who are in charge of managing Google Apps. The guide includes outlines and best practices for going Google as well as training, professional development and change management, integration of third party content and curriculum, and information on support. The guide is not technical and does not include specific steps to integrate Google Apps into schools.

Deployment and Implementation
Google has many different resources for getting started, deployment, and implementation information. The resources are a mix of guides, videos, webinars, and case studies.

Google Apps and Classroom Resources

• Google Apps Deployment Guide
• Google for Education Learning Center
• Google Classroom 101

76 https://www.google.com/edu/case-studies/
77 https://docs.google.com/a/clarity-innovations.com/file/d/0B_OTXR_u3RbZnRmVnNHeFdydlik/edit
78 https://support.google.com/chrome/a/answer/3273084?hl=en
79 https://support.google.com/chrome/a/answer/2636425?hl=en
80 https://docs.google.com/document/d/1NrlRPH0df5SaYyUqj5u_x0F4NxXEEt3i5Gltf45EvqQ/edit?usp=sharing
• Teacher Tips for Google Classroom
• Google Apps Guide to Going Google
• Google Apps Domain Best Practices
• Google Apps Technical Transition Guide

Chromebook Resources
• Chrome Device Quick Start Guide
• Google Chromebook Deployment Guide
• Chromebook Webinars (live and recorded)
• Management Console Overview
• Play for Education for Chromebooks
• 30 Ways to Use Chromebooks in the Classroom
• Chrome Web Store

Tablets with Google Play Resources
• How-to Videos
• 75 Apps for Your Class
• Top Apps to Use
• Google Play Case Studies
• Teaching with Play for Education (videos)

Hire a Trainer
Google has a program set up where schools or districts can hire experts to help with various topics including training and professional development, connecting with other educators and schools and help with Google Apps implementation. The trainers are either Google Education Trainers, Google Certified Teachers, Partner organizations or reference schools.81

Support
Google offers help centers for GAFE, Chrome for Work and Education, and Google Play for Education. The pages include how-to information as well as troubleshooting and a help forum. Google has instructions for how to contact a user specific Google Apps Administrator, but does not make the number readily available through the general help page.

81 https://edudirectory.withgoogle.com/static/index.html#/
STUDENT DATA PRIVACY AND SECURITY

Privacy
Google does not place advertisements in GAFE or show ads when students use Google Search while signed into their GAFE accounts. Additionally, the data that is collected is owned by schools, not Google. Google will keep the data for as long as schools require them to keep it.82

Google scans student Gmail accounts and GAFE accounts for virus and spam protection, spell check, relevant search results, priority inbox, and auto-detection of calendar events. Google explicitly states on its privacy FAQ website “We do NOT scan Google Apps for Education emails for advertising”83

To further help with student data privacy and online safety, Google has a Family Safety Center that helps parents learn how to keep themselves and their family safe online. It also helps teach parents how to find age-appropriate content, how to judge content for credibility, and how to manage their online reputations.

Security
To help make sure students are safe online, Google has also put some security measures in place. Google runs its own custom server, which runs custom operating and files system that is optimized for security and performance. All data sent from Gmail, attachments and all drive data is encrypted in order to keep messages safe.

Google uses independent third party auditors to examine their data centers, infrastructure and operations to ensure that they keep data secure. They undergo the audits on a regular basis and make those certificates and audit reports available to the public.84

Google Vault
Google Vault is a feature that is included with Google Drive for Education that lets schools retain, archive, search and export any email or chat records of users within the organization.85 It provides the following services:

• Email and Chat archiving – retention rules can be set for how long emails and chat records are kept before they are removed from user mailboxes and deleted. The records are searchable within Vault for 30 days after the messages are removed from a user’s inbox. After the 30 days are up, the messages are forever deleted.

• Legal Holds – A legal hold can be placed on a user’s account indefinitely to meet legal obligations. If a user deletes and email, it is removed from their view, but it is still maintained in Vault.

• Search – Email, chat and Drive accounts can be searched by account, organization, date or keyword.

• Export – records from email, chat and Drive accounts can be exported for additional review.

82 https://www.google.com/edu/trust/
83 https://support.google.com/googleforwork/answer/6056650?hl=en
84 https://support.google.com/googleforwork/answer/6056694
85 https://support.google.com/vault/answer/2462365?hl=en
• Audit Reports – these reports show details about actions that Vault users have taken during a specific time frame. Anyone who is authorized to sign into Vault and perform actions is considered a Vault user.

Privacy Issues
Google encountered issues with student data privacy in March 2014 when they admitted to scanning and indexing content from student emails for advertising purposes. The admission came out during litigation from a lawsuit in which students and other Gmail users sued Google, claiming that scanning violated wiretap laws. Although ads were not placed within GAFE, the information gathered from student accounts could have been used to target ads to students when they were elsewhere online; however, Google said the information was never used for those purposes.

The lawsuit also brought up questions about how FERPA would be interpreted with the emergence of digital technologies in the classroom. The U.S. Department of Education released a document on best practices for protecting student data when using online education services, which makes it appear as though the practices of GAFE appeared to be in violation of FERPA.86

After these allegations of student data mining, Google announced in April 2014 that it stopped scanning student Gmail accounts for advertising. They also removed the option within GAFE that allowed administrators to turn on advertisements.

Although Google has since stopped mining student data for advertising purposes, there has been substantial concern over Google’s practices around student data privacy. During the lawsuit, Houston ISD announced that they chose to contract with Microsoft to use their Microsoft Office 365 solution instead of GAFE, partly because of the way Google handled student privacy. The Houston ISD Chief Technology Officer, Larry Schad, said the data mining practices of Google, as well as their lack of responsiveness to his concerns, were a red flag.

On September 29, 2014, California signed the Student Online Personal Information Protection Act, or SOPIPA, into law, prohibiting online education service operators from selling student data, using student data to target advertising, or to form a profile of students for non-educational purposes. One of the main drivers for the bill was the admission by Google about scanning student emails for advertising.87

87 http://www.edweek.org/ew/articles/2014/03/13/26google.h33.html
Case Studies

**CHROMEBOOKS**

**Richland School District Two**
Richland School District Two is located in South Carolina and has a student population of 27,000. The district has implemented a 1 to 1 program in grades 3-12, with a total of 22,500 Chromebooks being used. The district chose Chromebooks in order to create, communicate and research using GAFE. It also cites Chromebooks multimedia tools, quick boot and login feature, and ease of deployment as reasons for adoption. Intel-based Lenovo X131E devices were chosen due to the performance and battery life as well as its removable and replaceable batteries.88

**Virginia Chesterfield**
Virginia's Chesterfield County Schools announced in June 2014 that it would deploy 32,000 Chromebooks, which was the largest Chromebook deployment at the time. After a pilot program where the district tested iPads, Chromebooks, Windows 7 laptops, Windows 8 tablets, Kindle Fires, and an Android tablet, the district narrowed down the decision to the Windows 7 laptop and the Chromebook. Due to price, Chromebooks won and were deployed to all middle and high school students to start.89

**Montgomery County Schools**
Shortly after Virginia Chesterfield, Maryland announced the largest Chromebook deployment to date, Montgomery County Public Schools (MCPS) announced an even bigger deployment of 40,000 Chromebooks. The district spent $15 million to get the first year of the program funded. The goal was to give 30,000 devices to students in grades 3, 5, and 6 and dedicate 10,000 devices for high school social studies classes. MCPS will eventually have over 100,000 devices including both Chromebooks for grades 3-12 and Android tablets with Google Play for Education for grades K-2.90

**Hillsborough School District Chooses Chromebooks over iPads**
The Hillsborough Township School District in New Jersey spent a year piloting both iPads and Chromebooks to decide which was the best for interactive learning. The district chose Chromebooks for many reasons including the keyboard, easier collaboration with Google Apps, tech support, and focus on work vs. play.91

88 [http://www.k12blueprint.com/content/1two1-richland-county-school-district-two](http://www.k12blueprint.com/content/1two1-richland-county-school-district-two)
TABLETS WITH GOOGLE PLAY FOR EDUCATION

Kipp Bridge Charter School
Kipp Bridge is a part of national network of free public charter schools. It is located in Oakland, California and has 319 students in grades 5-8. The school has a focus on preparing students for college and careers, and previously had very little technology in the classroom. In addition, many students did not have Internet access at home. The school chose the Nexus 7 tablets with Google Play for Education. The tablets have allowed the students to have access to resources they previously did not have access to, as well as allow for individualization and creativity.92

Hillsborough Township Public Schools
In addition to Chromebooks, Hillsborough Township Public Schools also purchased 3,000 Nexus 7 tablets with Google Play for Education for its students in grades K-4. The district found the devices easy to use and set up and liked the wide range of apps available as well as the easy access to Google Apps.93

GAFE AND CLASSROOM

Oregon Chooses GAFE
In April 2010, Oregon became the first state to announce the use of GAFE statewide. The Oregon Department of Education left the option open for schools to decide whether they wanted to adopt GAFE or not, and saved the state $1.5 million in IT costs since the service is completely web-based.94

Clarkstown Central School District pilots Classroom
The southern New York district that serves 8,600 students was approached by Google to test out their new product, Classroom, and to provide feedback to Google. It said that the major benefits of Classroom were increased student engagement and improved organization. After testing out the product, the district planned to make Classroom available to all teachers for the 2014/2015 school year.95

Selected References

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