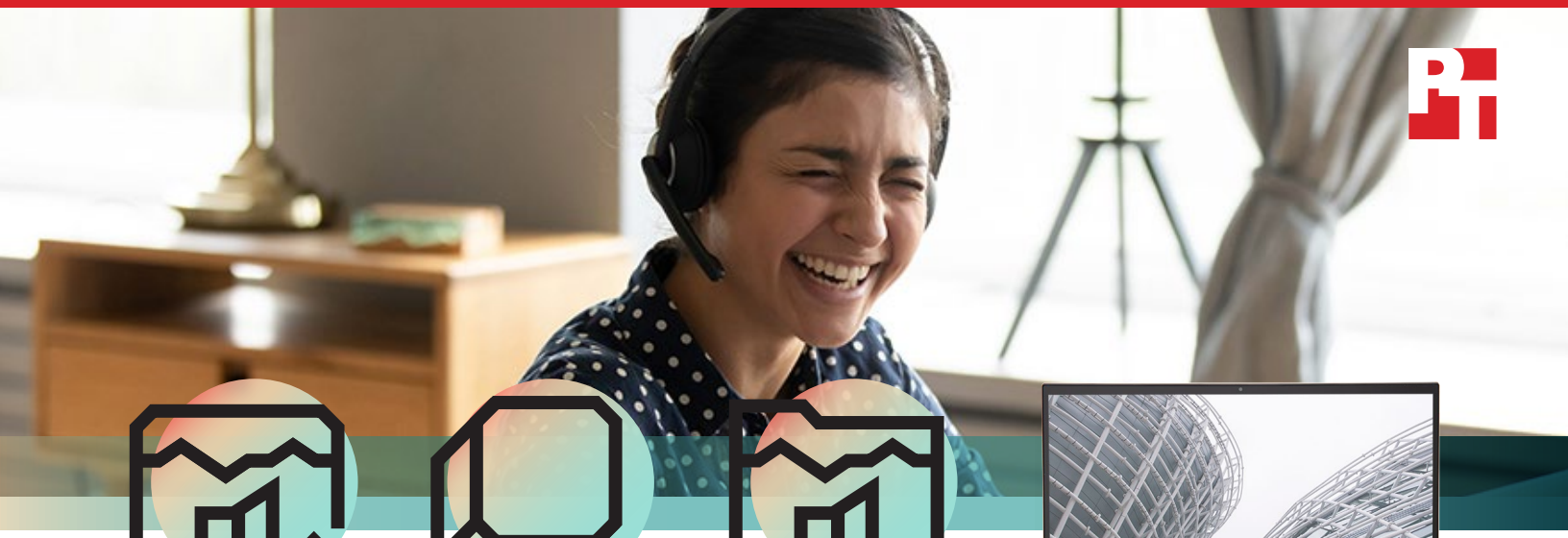


Up to **57%** faster exporting an audio file†Δ

Up to **22%** faster opening a 3D model†Δ

Up to **28%** faster opening an audio file†Δ

Chromebook powered by an Intel Core i3-10110U processor†Δ

Work and collaborate remotely with an Intel processor-powered Chromebook

In our tests, an Intel® Core™ i3 processor-powered Chromebook™ completed tasks in several educational apps in less time than an A10 Fusion processor-powered Apple® iPad®†

At Principled Technologies, we tested two devices: an Intel Core i3 processor-powered Chromebook and an A10 Fusion processor-powered iPad. We found that the Intel Core i3 processor-powered Chromebook completed six tasks in five educational apps in less time than the A10 Fusion processor-powered iPad.

With remote learning the new norm during the COVID-19 epidemic, students of all ages are relying on their devices for more than just homework and off-hours diversions: The device is now the primary medium for education.

You have a wealth of options when it comes to student devices. Device size, manufacturer, processor, system memory, and operating system all affect the user experience. Chromebooks (based on Google Chrome OS) and Apple iPad devices (based on iOS) are two options we investigated in this paper to better understand their advantages in a distance learning setting.

†ASUS Chromebook C436F powered by an Intel Core i3-10110U processor compared to an Apple iPad 10.2" 7th Gen A2197 with an Apple Fusion processor.
ΔSee the **science behind this report** for detailed system configurations and benchmark results.

Feature comparison

In our review of the Intel Core i3 processor-powered Chromebook we tested—the ASUS Chromebook C436F—we found several key hardware differences that could translate to benefits for your students when compared to the A10 Fusion processor-powered 7th generation Apple iPad.

In this report, text in **pink sections** represents fictional scenarios based on the results of PT testing.

New Chromebooks in a new normal

Butler Middle School recently purchased Intel Core i3 processor-powered Chromebooks for their students to take home and use for distance learning. How do they compare to an A10 Fusion processor-powered iPad alternative? See it for yourself on the following pages. The Intel Core i3 processor-powered Chromebook enables the students and teachers of Butler Middle School to complete tasks in audio editing, 3D modeling, coding, and lesson planning apps in less time than they would have with the A10 Fusion processor-powered iPad.

Table 1: Hardware comparison of the ASUS Chromebook C426F and the 7th generation Apple iPad. Source: Principled Technologies.

	 ASUS Chromebook C436F with an Intel Core i3-10110U processor	 Apple iPad 10.2" 7th Gen A2197 with an Apple Fusion processor	**Chromebook benefit**
Ports	2x USB-C	1x Lightning	More flexibility to plug in more simultaneous external devices or storage
Keyboard	Has embedded keyboard with trackpad	Users must buy keyboard separately	Embedded keyboard means one less thing for students to lose
Form factor	360° hinge enables students to use the Chromebook as a laptop or tablet	Mainly a tablet, but you can add a keyboard attachment at an additional cost	Versatile form factor offers students more choices for how to use the device
Display size	14 inches	10.2 inches	More screen real estate helps students see more
microSD slot	Yes	No	Allows for quick and easy media sharing

[Δ]See the **science behind this report** for detailed system configurations and benchmark results.

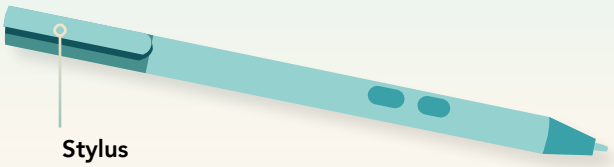
Touch capabilities
Both the 7th generation iPad and the Chromebook we tested offer touch capabilities.

More processor options
This Chromebook is available with several different Intel processor options, allowing schools and districts to tailor the devices to their needs and budget.

Wi-Fi 6 support
If a student's router uses Wi-Fi 6, the latest technology from Wi-Fi Alliance, this Chromebook can enable them to take full advantage of it. The iPad we tested does not support Wi-Fi 6.

Speakers
This Chromebook features four omnidirectional speakers certified by Harmon Kardon.

Chromebook powered by an Intel Core i3-10110U processor†Δ



Stylus
While both devices support an optional stylus, the Apple Pencil is $99, while the ASUS* Active Stylus costs $59.99.[1,2]

Trackpad
This Chromebook comes with an attached keyboard. The iPad does not; however, you can buy one separately. The Apple Smart Keyboard does not include a trackpad and costs $159; however, the Logitech Combo Touch Keyboard for iPad—which does include a trackpad—is available for $149.99.[3,4]

Price
As of this writing, the list price for the ASUS Chromebook C436F is $799.99.[5] While the 7th generation iPad costs $329, it lacks a keyboard, which comes standard with a Chromebook.[6] Depending on which keyboard one may consider for the iPad, the total price would be anywhere from $478.95 to $488.

†ASUS Chromebook C436F powered by an Intel Core i3-10110U processor compared to an Apple iPad 10.2" 7th Gen A2197 with an Apple Fusion processor.
ΔSee the **science behind this report** for detailed system configurations and benchmark results.

Complete tasks in less time

When it comes to productivity, tasks in a variety of apps were faster with the Intel Core i3 processor-powered Chromebook we tested compared to the A10 Fusion processor-powered iPad. Students could benefit from a device that enables them to quickly complete work in a diverse range of applications, as they will often need to use many different apps within a single day.

Google Meet

Because student devices are now the primary mode of receiving teacher instruction and communicating with peers, video conferencing performance is important to consider when researching devices. In our tests, the Intel Core i3 processor-powered Chromebook launched a new meeting in 2.9 seconds compared to 4.8 for the A10 Fusion processor-powered iPad.

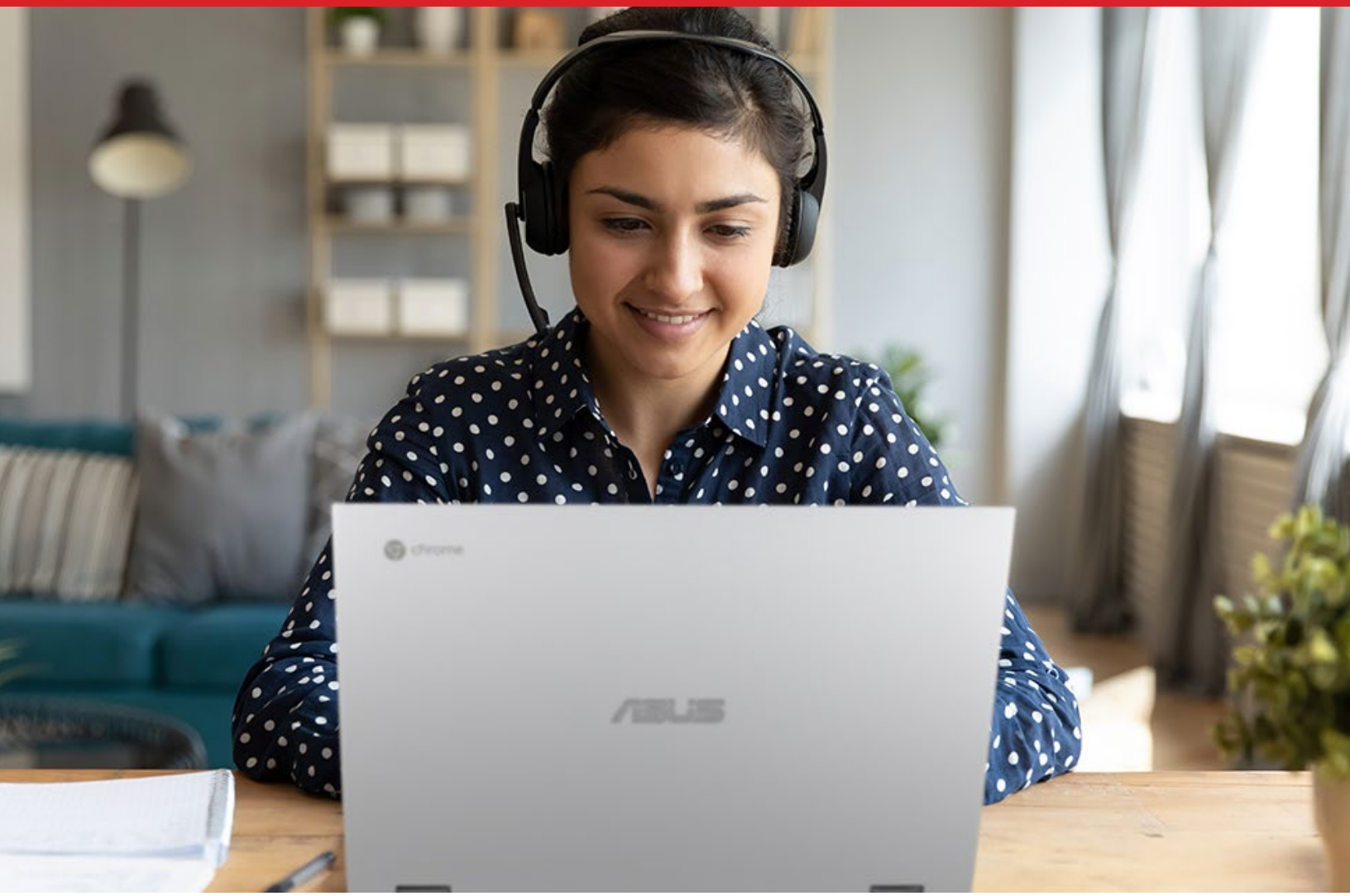
Save up to 1.9 seconds launching a new meeting
with Google Meet

Figure 1: Time (in seconds) to launch a new meeting with Google Meet. Lower is better.
Source: Principled Technologies.

Google Meet

Google has made their premium video conferencing product free and available to the general public. According to Google, the app is used in schools, governments, and companies worldwide.[7]

△See the **science behind this report** for detailed system configurations and benchmark results.



Save up to 2.4 seconds opening a presentation

with Explain Everything

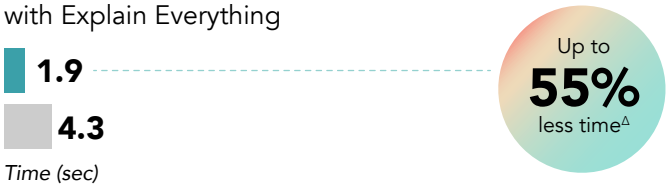


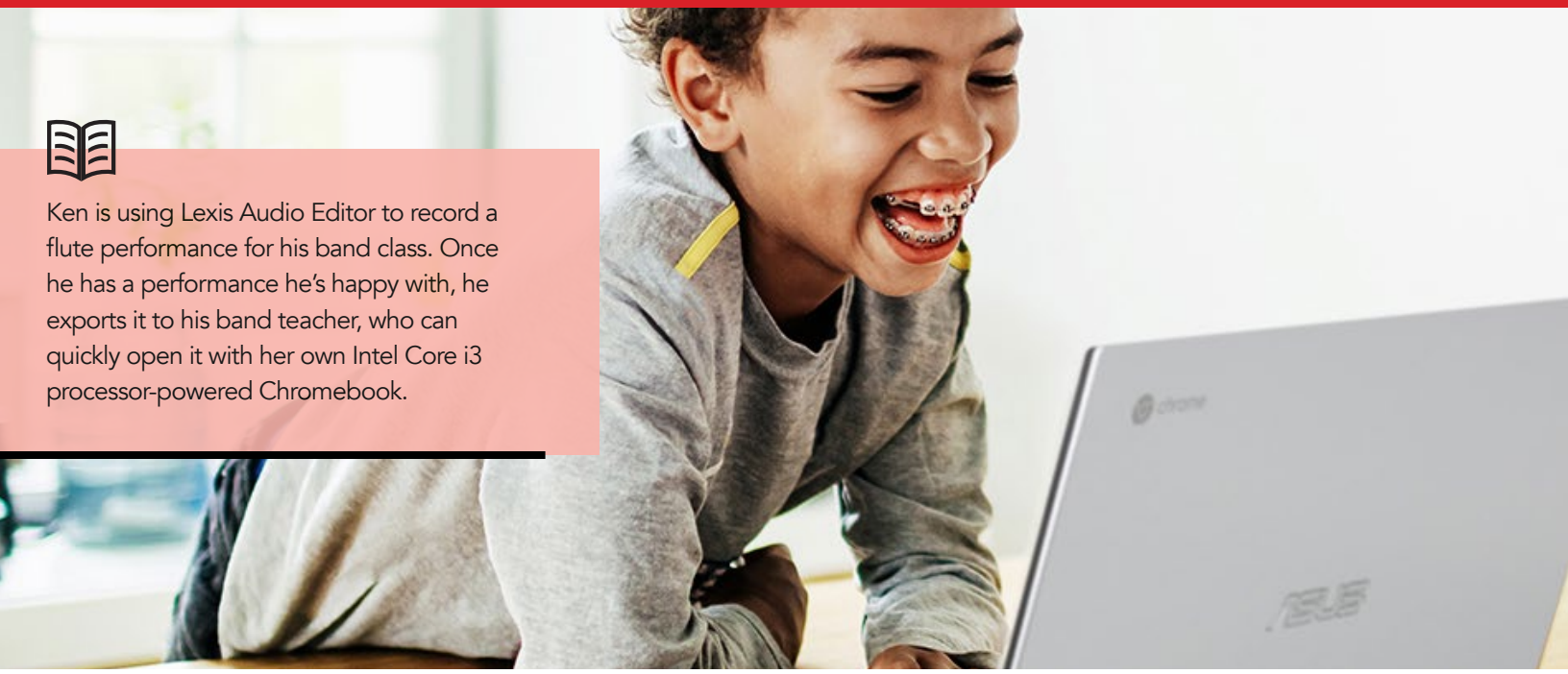
Figure 2: Time (in seconds) to open a presentation in Explain Everything. Lower is better.
Source: Principled Technologies.

Edi Khoury is a Butler Middle School teacher who uses her school-issued Chromebook to prepare for lessons and hold conversations with more than a hundred students per day. With Google Meet, each of her classes runs smoothly—and Explain Everything helps her make plans for the next. The device's screen is larger than that of an iPad's, which she appreciates.

Explain Everything

Explain Everything is an interactive whiteboard app that lets teachers and students can collaborate in real time.[8] According to TechCrunch, the Los Angeles public school district installed it on 70,000 educational tablets. In 2014, the software could be found on 50 percent of all educational iPads in the UK.[9]

[Δ]See the **science behind this report** for detailed system configurations and benchmark results.



Ken is using Lexis Audio Editor to record a flute performance for his band class. Once he has a performance he's happy with, he exports it to his band teacher, who can quickly open it with her own Intel Core i3 processor-powered Chromebook.

Students use their devices for more than just writing book reports. Schools are increasingly using creative apps to help their students prepare for and thrive in a digital world. In our tests, the Intel Core i3 processor-powered Chromebook enabled us to complete tasks in audio and 3D modeling software in less time than the A10 Fusion processor-powered iPad.

Save up to 53.5 seconds exporting an audio file after editing

with Lexis Audio Editor

Figure 3: Time (in seconds) to export an audio file after editing with Lexis Audio Editor. Lower is better. Source: Principled Technologies.

Save up to 3.3 seconds opening a 50MB audio file

with Lexis Audio Editor

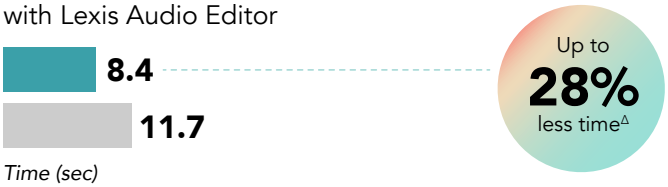


Figure 4: Time (in seconds) to open a 50MB audio file in Lexis Audio Editor. Lower is better. Source: Principled Technologies.

Save up to 6.2 seconds opening the Retail Row model

with Tinkercad*

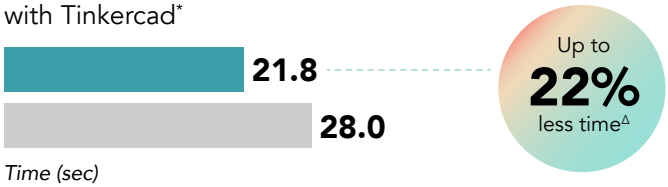


Figure 5: Time (in seconds) to open a 3D model titled Retail Row in Tinkercad. Lower is better. Source: Principled Technologies.

Lexis Audio Editor

Lexis Audio Editor is an app that enables fast editing of audio recordings. Features include normalization, noise reduction, a 10-band equalizer, a compressor, and more.[10]

Tinkercad

Tinkercad is a browser-based program for computer-aided design.[11] Common Sense Education® gave Tinkercad a 4 out of 5 star rating, citing the app's pedagogical implications.[12]

△See the **science behind this report** for detailed system configurations and benchmark results.

Save up to 2.6 seconds opening the "from" block to code lesson

with Trinket

Figure 6: Time (in seconds) to open a code block lesson in Trinket. Source: Principled Technologies.

Though certain computer science concepts are difficult for students to grasp, the work is no match for the students' Intel Core i3 processor-powered devices. Take Sasha, who's been using Trinket to learn more about challenging "from" blocks. The Chromebook's built-in keyboard—which does not come standard with the iPad we tested—makes it easy to type in the necessary commands.

Trinket

Trinket allows users to create, run, and share code from their device and browser of choice. The company offers free support for educators who wish to use the web application for classroom instruction.[13]

Use Linux (Beta) for coding projects

Linux (Beta) enables Chromebooks to install and access a Linux terminal and use Linux applications. Linux (Beta) offers flexibility to students looking to install coding and development tools, open source software, or applications that otherwise might not be available on the Google Chrome or Play Store. The Linux environment is isolated from the rest of the Chromebook, meaning that Linux apps can't affect the rest of the system.

[Δ]See the **science behind this report** for detailed system configurations and benchmark results.

Conclusion

Education may look different while the world is dealing with COVID-19, but you still have the power to help shape student learning outcomes for the better. Like the students and teachers of the fictional Butler Middle School, your students and faculty could use their Intel Core i3 processor-powered Chromebooks to complete their work more quickly and to facilitate the communication apps that allow them to connect with their peers and teachers. In our hands-on tests, an Intel Core i3 processor-powered Chromebook enabled us to complete several tasks in educational apps in less time than an A10 Fusion processor-powered iPad.

Chromebook powered by an Intel Core i3-10110U processor

For more information on Intel Education Chromebooks, visit https://www.intel.com/content/www/us/en/education/right-device/chromebooks-for-education.html.

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3 "Smart Keyboard for iPad (7th generation) and iPad Air (3rd generation)," accessed July 7, 2020, https://www.apple.com/shop/product/MX3L2LL/A/.

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7 Javier Soltero, "Google Meet premium video meetings—free for everyone," accessed June 3, 2020, https://www.blog.google/products/meet/bringing-google-meet-to-more-people/.

8 "Explain Everything | Interactive Whiteboard With Real-Time Communication," accessed April 23, 2020, https://explaineverything.com/.

9 John Biggs, "Explain Everything, the digital whiteboard, raises $3.7 million to bring learning to the iPad," accessed April 23, 2020, https://techcrunch.com/2016/12/15/explaineverything-the-digital-whiteboard-raises-3-7-million-to-bring-learning-to-the-ipad/.

10 Google Play, "Lexis Audio Editor," accessed April 17, 2020, https://play.google.com/store/apps/details?id=com.pamsys.lexisaudioeditor.

11 "Tinkercad – Chrome Web Store," accessed April 23, 2020, https://chrome.google.com/webstore/detail/tinkercad/bhggmehigifnpflipbkdfcjiacpcgidn.

12 Marianne Rogowski, "Tinkercad Review for Teachers | Common Sense Education," accessed April 23, 2020, https://www.commonsense.org/education/website/tinkercad.

13 "Trinket," accessed April 23, 2020, https://trinket.io/.

We concluded our hands-on testing on June 1, 2020. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on May 18, 2020 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

Table 1: Time in seconds to complete tasks in various apps.

Task	ASUS* Chromebook C436F with an **Intel® Core™ i3-10110U processor**	Apple® iPad® 10.2" 7th Gen A2197 with an **Apple A10 Fusion processor**	**Chromebook™ percentage win**
Google Meet			
Launching a new meeting	2.9	4.8	**39%**
Explain Everything			
Opening a local presentation	1.9	4.3	**55%**
Trinket			
Opening the "from" block to code Lesson	4.3	6.9	**37%**
Tinkercad			
Opening a 3D model	21.8	28.0	**22%**
Lexis Audio Editor			
Exporting an audio file	41.1	94.6	**56%**
Opening an audio file	8.4	11.7	**28%**

System configuration information

Table 2: The table below presents detailed information on the systems we tested.

System	ASUS Chromebook C436F with an **Intel Core i3-10110U processor**	Apple iPad 10.2" 7th Gen A2197 with an **Apple A10 Fusion processor**
Processor	Intel Core i3-10110U	Apple A10 Fusion
Processor frequency (GHz)	2.1	2.34
Processor cores	2	4
Memory (GB)	8	3
Storage (GB)	128	32
Bluetooth	4.2	4.2
USB	2x USB 3.1 Type-C	Lightning to USB Cable included
Battery type	Lithium-Ion	Lithium-polymer
Battery capacity (Wh)	47	32.4
Display	14" 1920 x 1080	10.2" 2160 x 1620
OS (version)	81.0.4044.141	13.4.1
System weight (lbs.)	3.09	1.07

How we tested

Creating the background workload

To simulate typical use, we ran a combination of news, email, chat, music, document viewing, and social media websites in the background. For websites that required accounts, we created test profiles and logged in the users on each device. We opened a Chrome browser with the following tabs:

1. From the shelf, open Chromebook settings.
2. Navigate to the On Startup section of the settings.
3. Select Open a specific page or set of pages.
4. Insert the following URLs, and click OK.

    - Forbes.com
    - Markets.ft.com/data
    - Arstechnica.com
    - mail.google.com
    - slack.com (logged into Slack chat, #general channel)
    - drive.google.com
    - docs.google.com (viewing document)
    - youtube.com/feed/music
    - drive.google.com (viewing document)
    - sheets.google.com (viewing spreadsheet)
    - twitter.com
    - facebook.com

5. Restart the Chromebook. Before testing, navigate through each tab to ensure that both devices have fully loaded the same content.

Testing the applications

Google Meet

Launching a new meeting

1. From the Google Play Store or the Apple App Store, install Google Meet.
2. Launch the Google Meet app.
3. Simultaneously start the timer and click New Meeting.
4. Stop the timer when the meeting invite appears.

Explain Everything

Open local presentation

1. From the Google Play store or Apple App Store, install Explain Everything.
2. Launch the Explain Everything app.
3. Simultaneously start the timer and click the test project.
4. When the test project has fully loaded, stop the timer.

Lexis Audio Editor

Opening a 50MB audio file

1. From the Google Play Store or the Apple App Store, install Lexis Audio Editor.
2. Launch the app.
3. To enable app access to photos, media, and files on the device, click Allow.
4. Close and reopen the app.
5. Click Open.
6. Navigate to the device's download folder, and select the test audio file.
7. Start the timer, and click Open.
8. Stop the timer when the audio file has fully loaded.

Exporting an edited audio file

1. Launch the Lexis Audio Editor app.
2. Click Open.
3. Navigate to the device's download folder, and select the test audio file.
4. Click Save.
5. From the Save menu, enter a file name. Start the timer, and click Save.
6. Stop the timer when saving completes.

Tinkercad

Opening the Retail Row model

1. From the Chrome browser, navigate to tinkercad.com.
2. Click Gallery.
3. Click the Retail Row design.
4. Simultaneously start the timer and click Copy and Tinker.
5. When the model fully loads, stop the timer.

Trinket

Opening the "From Block to Code" lesson

1. From the Chrome browser, navigate to trinket.io.
2. Sign in with your Google account.
3. Click Learn.
4. Simultaneously start the timer and click Let's Go under From Blocks to Code.
5. When the project editor fully loads, stop the timer.

Intel contributes to the development of benchmarks by participating in, sponsoring, and/or contributing technical support to various benchmarking groups, including the BenchmarkXPRT Development Community administered by Principled Technologies.

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors.

Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit www.intel.com/benchmarks.

Intel's compilers may or may not optimize to the same degree for non-Intel microprocessors for optimizations that are not unique to Intel microprocessors. These optimizations include SSE2, SSE3, and SSSE3 instruction sets and other optimizations. Intel does not guarantee the availability, functionality, or effectiveness of any optimization on microprocessors not manufactured by Intel. Microprocessor-dependent optimizations in this product are intended for use with Intel microprocessors. Certain optimizations not specific to Intel microarchitecture are reserved for Intel microprocessors. Please refer to the applicable product User and Reference Guides for more information regarding the specific instruction sets covered by this notice.

Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates. See backup for configuration details. No product or component can be absolutely secure.

Your costs and results may vary.

Intel technologies may require enabled hardware, software or service activation.

This project was commissioned by Intel.

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