Save 25 seconds each time you export an audio file with the **Intel Core m3 processor-powered Chromebook.***

Save 18 seconds more with the **Intel Core i3 processor-powered Chromebook.***

Chromebook with an Intel Celeron N4020 processor

Chromebook with an Intel Core m3-8100Y processor

Chromebook with an Intel Core i3-10110U processor

Help students connect and collaborate to finish creative assignments with Intel Core processor-powered Chromebooks™

Hands-on testing demonstrated that Chromebooks powered by two types of Intel® Core® processors saved time on creative and educational tasks

At Principled Technologies, we used three Intel® processor-powered Chromebooks to perform tasks in creative apps:

- Intel Celeron® N4020 processor-powered Chromebook
- Intel Core™ m3-8100Y processor-powered Chromebook
- Intel Core i3-10110U processor-powered Chromebook

We measured the time required to complete nine tasks in creative and educational apps on each device. Though the Intel Celeron N4020 processor-powered Chromebook completed each task, its Intel Core m3-8100Y processor-powered counterpart was faster, and the Chromebook powered by an Intel Core i3-10110U processor was consistently the fastest of all three devices.*

With distance learning becoming a new standard for education, individual students have more work to do at home. Your choice of device now may have more influence on the quality of a student's education as well as a student's ability to perform.

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

Chromebooks for multimedia projects

Mrs. Brechner's class is all about helping kids become fluent with new technologies in the digital age. The skills she teaches in class are even more applicable now that more people are connecting and collaborating over the internet. So far, the students have explored working with audio, video, 3D models, and even a bit of coding in Python®. For their next big project, Mrs. Brechner is going to have the students pick the focus area they enjoyed the most and collaborate with each other online to create a multimedia project.

With the school's new Chromebooks, Mrs. Brechner would normally expect to see big improvements and less frustration—but she's concerned about the impact the pandemic may have on student success.

Things are off to a good start, though. Google Meet lets her communicate with her students—and even their parents, which is nice. Plus, the Chromebooks can handle Google Meet while running their other work in the background.

Fictional scenario

With schools moving to online platforms, the choice of which student device to purchase is likely to be more important now than before. The students at our fictional Keyes Middle School use a new Chromebook for their studies: the 10th generation Intel Core i3 processor-powered Chromebook. How would it compare to the other devices that were on the school's shortlist? Read the rest of this PT testing-based scenario to find out.

Creating a new Python program
with CodeHS

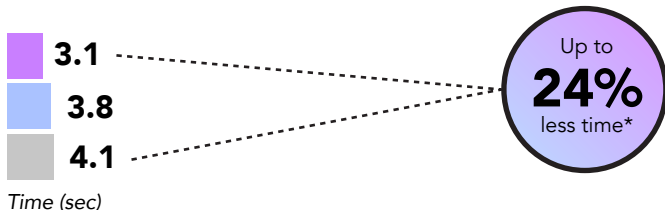|	Time (sec)	
🟪	**3.1**	Up to **24%** less time*
🟦	**3.8**	
⬜	**4.1**	

Figure 1: Time (in seconds) to create a new Python program in CodeHS. Lower is better. Source: Principled Technologies.

🟪 Chromebook with an Intel Core i3-10110U processor
🟦 Chromebook with an Intel Core m3-8100Y processor
⬜ Chromebook with an Intel Celeron N4020 processor

CodeHS

CodeHS provides tools and lessons to facilitate computer science education in schools. Erin Berenton of Common Sense Media gave the CodeHS website 4 out of 5 stars, saying the program makes things "accessible for beginners."[1]

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

Multitasking with Google Meet

Now that students are learning from home, their devices are doing more work. During virtual class sessions, students need a device that enables them to receive instruction from their teachers as they complete assignments at the same time. Fortunately, Mrs. Brechner's students have Intel Core i3-10110U processor-powered Chromebooks.

The new Chromebooks enable the students to open, review, and save documents and spreadsheets more quickly than the other two devices—and all while running Google Meet. This comes in handy as Mrs. Brechner is introducing the new class project. As she describes the project requirements, her students can follow along with the prepared notes and start brainstorming ideas of their own.

After letting the students sort themselves into groups and seeing how much the kids enjoy talking over Google Meet, Mrs. Brechner is cautiously hopeful about the remainder of the school year.

Print previewing a PDF from Google Drive
while multitasking with Google Meet

27.7
32.3
36.0

Up to
23%
less time*

Time (sec)
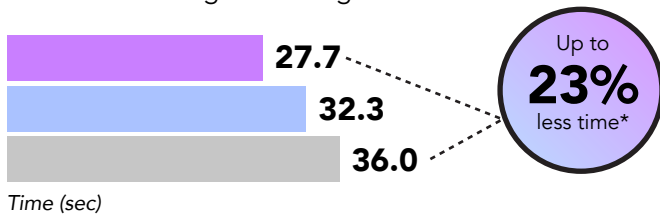
Figure 2: Time (in seconds) to print preview a PDF from Google Drive while multitasking with Google Meet. Lower is better. Source: Principled Technologies.

Saving and opening a DOCX to Google Docs
while multitasking with Google Meet

11.5
13.7
32.2

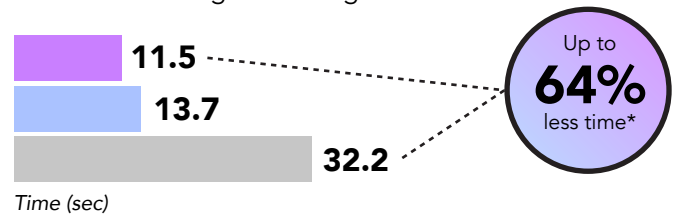Up to
64%
less time*

Time (sec)

Figure 4: Time (in seconds) to save and open a DOCX to Google Docs while multitasking with Google Meet. Lower is better. Source: Principled Technologies.

Opening a large DOCX file in Google Docs
while multitasking with Google Meet

6.5
11.0
16.3

Up to
60%
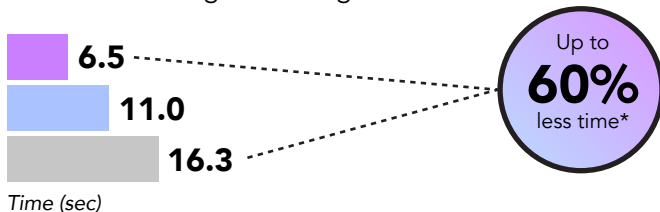less time*

Time (sec)

Figure 3: Time (in seconds) to open a large DOCX file in Google Docs while multitasking with Google Meet. Lower is better. Source: Principled Technologies.

Opening a shared Google Slides project
while multitasking with Google Meet

9.4
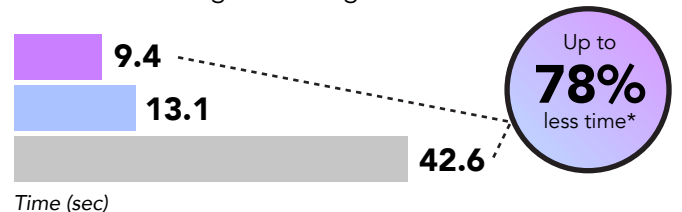13.1
42.6

Up to
78%
less time*

Time (sec)

Figure 5: Time (in seconds) to open a shared Google Slides project while multitasking with Google Meet. Lower is better. Source: Principled Technologies.

■ Chromebook with an Intel Core i3-10110U processor
■ Chromebook with an Intel Core m3-8100Y processor
■ Chromebook with an Intel Celeron N4020 processor

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.[2]

*See the **science behind this report** for detailed system configurations and benchmark results.
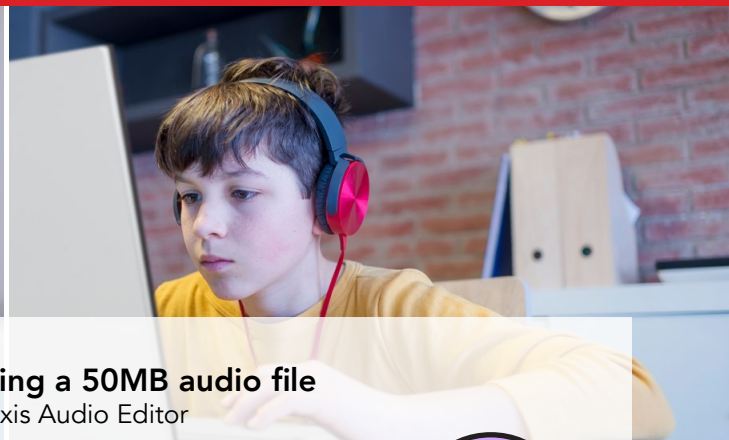
Editing audio for the project

Devon and Quinn are working on a song to use in the background of their group's video. As they chat over Google Meet, the pair decide they want to use real instruments as opposed to virtual ones.

In Lexis Audio Editor, it takes just under 9 seconds for Quinn to open a 50MB recording of Devon on piano. Quinn edits the recording so it can loop throughout the video, and exports the whole thing in just 41 seconds—up to 44 seconds faster than the other Chromebooks on the school's shortlist.

Later that day, Devon practices humming a soft tune to layer over the piano track. When it's time to record, it takes Devon just over 4 seconds to open the Soundtrap® studio session and get to work. By the end of the week, Devon and Quinn have created something special they're both proud of.

Opening a 50MB audio file
with Lexis Audio Editor

8.4
9.7
15.6

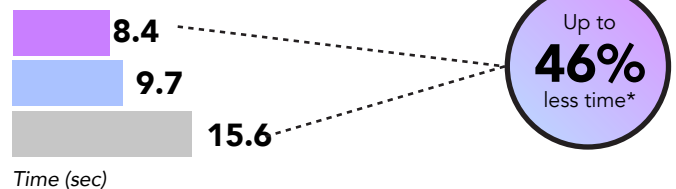*Time (sec)*

Up to **46%** less time*

Figure 6: Time (in seconds) to open a 50MB audio file in Lexis Audio Editor. Lower is better. Source: Principled Technologies.
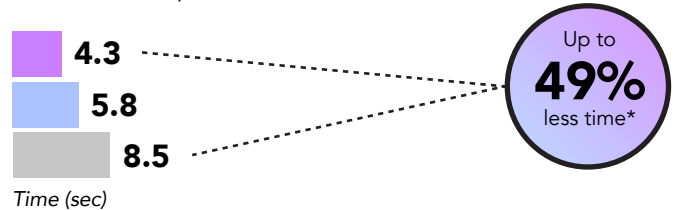
Entering the studio
with Soundtrap

4.3
5.8
8.5

Time (sec)

Up to **49%** less time*

Figure 7: Time (in seconds) to enter the Soundtrap studio. Lower is better. Source: Principled Technologies.

Exporting an audio file after editing
with Lexis Audio Editor

41.1
59.2
85.1

Time (sec)

Up to **52%** less time*

Figure 8: Time (in seconds) to export an audio file after editing in Lexis Audio Editor. Lower is better. Source: Principled Technologies.

■ Chromebook with an Intel Core i3-10110U processor
■ Chromebook with an Intel Core m3-8100Y processor
■ Chromebook with an Intel Celeron N4020 processor

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.[3]

Soundtrap

Soundtrap is a web application for creating digital audio creations such as music, podcasts, language studies, and more.[4] According to Soundtrap, more than 10,000 teachers worldwide trust their educational program.[5]

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

Opening the Retail Row model
with Tinkercad

21.8

25.6
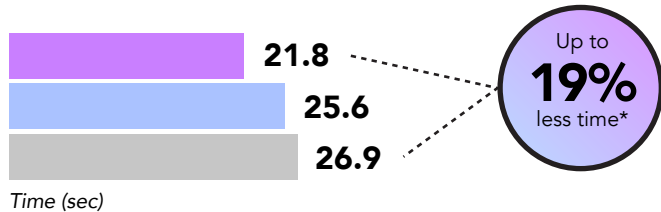
26.9

Up to
19%
less time*

Time (sec)

Figure 9: Time (in seconds) to open the Retail Row model with Tinkercad. Lower is better.
Source: Principled Technologies.

■ Chromebook with an Intel Core i3-10110U processor
■ Chromebook with an Intel Core m3-8100Y processor
■ Chromebook with an Intel Celeron N4020 processor

Exploring 3D modeling

Jules and Taylor are working on the group's video component. They plan to take the viewer on a journey through a level from a popular video game city to the tune of Devon and Quinn's song.

It takes just under 22 seconds for Jules to open a 3D model of a one of the game's levels in Tinkercad®. After recording a bunch of video clips, Jules passes the baton to Taylor, who tweaks and edits the clips together, perfecting the timing over the next couple of days. Google Meet enabled the pair to keep in contact and stay in sync while working on the project.

Tinkercad

Tinkercad is a browser-based program for computer-aided design.[6] Common Sense Education® gave Tinkercad a 4 out of 5 star rating, citing about the app's pedagogical implications.[7]

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

Chromebook with an Intel Core i3-10110U processor

Conclusion

A smile spreads across Mrs. Brechner's face as she watches the students share their works in progress during the class's regular Google Meet sessions. The collaboration and excitement she sees online makes her plenty proud of her students—and the assignment isn't due for another week! Having fast, responsive Chromebooks has enabled the students to explore their creativity in the apps we tested without the frustration of longer wait times. Mrs. Brechner is grateful—not just that the technology has enabled her students to accomplish so much while away from the school building, but that it's allowed her kids to see each other during a difficult time.

Our hands-on testing showed that, on nine tasks in creative and educational apps, an Intel Core i3-10110U processor-powered Chromebook could save time over a Chromebook powered by the Intel Core m3-8100Y processor and a Chromebook powered by the Intel Celeron N4020 processor. Each of these devices completed the tasks we tested, but the Intel Core i3 processor-powered device was the fastest of all. Responsive devices like the ones we tested can help keep students focused as they reap the benefits of innovative learning.

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

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1   Erin Berenton, "CodeHS Website Review," accessed April 17, 2020,
     https://www.commonsensemedia.org/website-reviews/codehs.

2   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/.

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

4   Google Play, "Soundtrap – Make Music Online," accessed April 17, 2020,
     https://play.google.com/store/apps/details?id=com.soundtrap.studioapp.

5   "Soundtrap," accessed April 17, 2020,
     https://www.soundtrap.com/edu/.

6   Chrome web store, "Tinkercad," accessed April 17, 2020,
     https://chrome.google.com/webstore/detail/tinkercad/bhggmehigifnpflipbkdfcjiacpcgidn.

7   Marianne Rogowski, "Tinkercad Review for Teachers," accessed April 17, 2020,
     https://www.commonsense.org/education/website/tinkercad.

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

We concluded our hands-on testing on May 29, 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 25, 2020 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

Our results

Table 1: Time to complete taskis in various apps. We present time in seconds below.

Task	HP Chromebook x360 11 G3 EE	ASUS Chromebook C434T	ASUS Chromebook C436F	Percentage win ASUS Chromebook C434T vs. HP Chromebook x360 11 G3 EE	Percentage win ASUS Chromebook C436F vs. ASUS Chromebook C434T	Percentage win ASUS Chromebook C436F vs. HP Chromebook x360 11 G3 EE
CodeHS						
Creating a new Python program	4.1	3.8	3.1	7%	18%	24%
Multitasking with Google Meet						
Print previewing a PDF from Google Drive	36.0	32.3	27.7	10%	14%	23%
Opening a large DOCX file in Google Docs	16.3	11.0	6.5	33%	41%	60%
Saving and opening a DOCX to Google Docs	32.2	13.7	11.5	57%	16%	64%
Opening a shared Google Slides project	42.6	13.1	9.4	69%	28%	78%
Lexis Audio Editor						
Exporting an edited audio file	85.1	59.2	41.1	30%	31%	52%
Opening a 50MB audio file	15.6	9.7	8.4	38%	12%	46%
Soundtrap						
Entering the studio	8.5	5.8	4.3	32%	26%	49%
Tinkercad						
Opening the Retail Row model	26.9	25.6	21.8	5%	15%	19%

System configuration information

Table 2: Detailed information on the systems we tested.

System	HP Chromebook x360 11 G3 EE	ASUS Chromebook C434T	ASUS Chromebook C436F
Processor	Intel Celeron N4020	Intel Core m3-8100Y	Intel Core i3-10110U
Processor frequency (GHz)	1.1	1.1	2.1
Processor cores	2	2	2
Memory (GB)	4	4	8
Storage (GB)	32	64	128
Bluetooth	5.0	4.0	4.2
USB	2x USB 3.1 Type-C 2x USB 3.1 Gen 1	1x USB 3.1 2x USB Type-C	2x USB 3.1 Type-C
Battery type	Lithium-Ion	Lithium-Ion	Lithium-Ion
Battery capacity (Wh)	47	48	47
Display	11.6" 1366 x 768	14" 1920 x 1080	14" 1920 x 1080
OS (version)	81.0.4044.103	81.0.4044.141	81.0.4044.141
System weight (lbs.)	3.19	3.19	3.09

How we tested

Creating the background workload

To simulate typical Chromebook 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.

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 all devices have fully loaded the same content.

Testing the applications

CodeHS

Creating a new Python program

1. From the Chrome browser, navigate to codehs.com.
2. Sign in with your Google account.
3. Click Sandbox.
4. Under Create New Program, type a name and click Create Program.
5. Select Python.
6. Simultaneously start the timer and click Create Program.
7. When the project editor fully loads, stop the timer.

Lexis Audio Editor

Opening a 50MB audio file

1. Install Lexis Audio Editor from the Google Play store, and pin the app to the shelf.
2. Launch the app from the shelf.
3. Click Allow to enable app access to photos, media, and files on the device.
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 app from the shelf.
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.

Soundtrap

Entering the studio
1. Install Soundtrap from the Google Play store, and pin the app to the shelf.
2. Launch the SoundTrap app from the shelf.
3. Simultaneously start the timer and click Create New Project.
4. When the studio fully loads, stop the timer.

Multitasking with Google Meet

For our multitasking tests, we opened Google Meet in Chrome, and joined a four-participant video meeting. We docked the Google Meet browser window to one half of the screen, and used the other half of the screen to complete the following scenarios. Our Chrome tab contained the background workload we described at the beginning of this section.

Joining a meeting
1. With Chrome open, open a new tab and enter the meeting URL.
2. Click to join the meeting, and ensure video is connected. For our testing, to ensure the video content was roughly the same across devices, we pointed each Chromebook's camera at a blank ceiling.
3. Dock the Chrome tab to the right side of the screen, and dock the other Chrome window to the left side of the screen.
4. In the left-docked Chrome window, complete the scenarios below.

Print previewing a PDF from Google Drive
1. From the Chrome browser, navigate to drive.google.com.
2. To preview the PDF test document, double-click its icon.
3. Simultaneously start the timer and click the Print icon.
4. When the print preview has fully loaded, stop the timer.

Saving and opening a DOCX to Google Docs
1. From the Chrome browser, navigate to drive.google.com.
2. To preview the DOCX test document, double-click its icon.
3. Click Open with Google Docs.
4. Click File.
5. Simultaneously start the timer and click Save as Google Docs.
6. When the new document has fully loaded, stop the timer.

Opening a large DOCX file In Google Docs
1. From the Chrome browser, navigate to drive.google.com.
2. To preview the DOCX test document, double-click its icon.
3. Simultaneously start the timer and click Open with Google Docs.
4. When the document has fully loaded, stop the timer.

This project was commissioned by Intel.

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